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THE ELEMENTS.

By WILLIAM CROOKES, F.R.S.

What are the elements? Those ingredients of which every natural substance is ultimately composed, and into which it may be resolved. Beings animate and inanimate, the earth beneath our feet, the stars revealed to us by the telescope, the minutest microbia which almost escape detection by our most improved microscope, all consist of elements. They make up all matter; they may be solid, liquid, or gaseous, perhaps even ultra-gaseous; they may exist in a state of absolute purity or in a state of mixture or combination. But we cannot destroy them, form them again, nor transmute one into another. They differ greatly in their properties, but still they have certain features in common. We know some seventy kinds of elements, apparently distinct; they all occupy space and all possess weight and inertia; they are the possible forms which matter, as we at present know it, assumes, and in some directions they are the present limits of our knowledge of nature.

The name "elements" has at different times been applied in very different ways. The ancient philosophers of Greece assumed the existence of four elements, *viz.*, earth, air, water and fire. But they used these words in a different sense from ours. Their earth was the principle of solidity, their

water that of liquidity, their air that of volubility or gaseity, and their fire might stand for energy, not a substance but a force.

The alchemists had three elements, sulphur, salt and mercury. But their sulphur was not our sulphur, but a mystical principle of inflammability; their mercury was not our mercury, but a supposed principle of metallity; and their salt meant solubility.

A little later the chemists of the eighteenth century conjured up an element which they named phlogiston, by which they sought to explain almost all chemical phenomena. The modern idea of force and energy is not greatly different from that which underlaid the term phlogiston.

The modern chemical elements have in them nothing metaphysical and mystical. They are simply those bodies which never diminish in weight as a consequence of any chemical reaction. We can add to them but we can take nothing away from them. It must not, however, be rashly inferred that our elements are absolutely incapable of decomposition. All that we are entitled to say is simply that hitherto we have not been able to decompose them. To-morrow we may possibly find a method by which they may be resolved into something simpler. Indeed, a variety of considerations lead us to suppose that such will ultimately be the case. To find out these absolute elements should be the grand goal of modern chemistry.

The elements may be regarded as common or as rare. But we must remember that our knowledge of the composition of the earth's body is very imperfect, superficial in the most literal sense. Of its interior we know no more than we do of some of the neighboring planets—in some respects even less. Could we penetrate but ten miles downward we might encounter startling results. Few parts even of the earth's surface have been so fully explored that we can assert what they may or may not contain; this is eminently the case with those vast regions which lie beneath the sea. Even concerning the accessible portions of the globe it often happens that elements little known are found to be comparatively plentiful

if they are sought for with care. So long as any substance is regarded as worthless the prospector and the miner pass it over with indifference. As instances we may mention strontium, which is now used in refining beet sugar; lithium and cerium, which are used in medicine; yttrium, which is used for lighting purposes, and vanadium, once sold at 1*s.* 6*d.* a grain, and now obtained in sufficient quantity to be used in producing aniline blacks in the tissue printing works. Even nickel has been obtained in much larger quantities since its extended uses in the arts have led to its being more carefully sought for. On the other hand, tellurium and thallium are at present being thrown away in quantity because the demand is insufficient for any one to care to incur the expense of their collection.

An important step toward an understanding of the origin of the elements and their mutual relations has been effected by the periodic law of Newlands and Mendeleeff. If we arrange the elements in the order of their atomic weights, it has been found that many of their properties appear as a periodic function of these weights. Here, however, much work still remains to be done before the periodic law can stand on the same plane of probability as the atomic theory or the law of Avogadro. Some elements seem equally entitled to more than one place in the classification; some of the atomic weights, such as those of nickel and cobalt, approach each other too closely, whilst in other parts of the series inconvenient gaps occur. Some of these may be filled up by the metals of the so-called rare earths.

The periodic law seems to throw a strong light on the probable formation of the elements. We cannot suppose that they have existed as we now find them from all eternity, nor yet that they have at some unknown time originated by accident; against such a supposition the probability is many millions to one. Nor is it reasonable to imagine that they were created suddenly, such as we now find them, by a special *fiat*. The most probable view is that they have been gradually evolved on a fore-ordained plan, which we are now beginning to perceive.

XUM

The gaps in Mendeleeff's system, and the rare earths which seem likely to fill them, occur at about the same places. It is also noteworthy that the minerals containing the rare earths are very unequally distributed. Siberia, Norway and certain regions of the United States seem to be their chief localities. In other countries, so far as exploration has determined, they appear to be absent. How is this? It may be that when all parts of the earth have been thoroughly explored, we shall obtain supplies of the rare earths from Australia, from India, or Africa. It may be that the conditions under which the primitive universal element (or as I have elsewhere ventured to call it after the example of Roger Bacon, the *protyl*) has been developed into such elements as scandium, yttrium, ytterbium, erbium and their associates, have been of exceedingly rare and of local occurrence. Or it perhaps may be that these elements have been formed not on our globe at all, but in some other portion of space, and may then have reached us in the form of a shower —or showers—of meteoric stones. According to present appearances, the minerals containing the rare earths are confined to the northern hemisphere. The supposed meteoric shower which brought them to our globe, falling at intervals during twenty-four hours on the upper half of the northern hemisphere, would pass over Siberia, Norway, the north Atlantic and North America. In this connection we may mention that pure crystalline carbon, in the form of the diamond, which is also assumed by some geologists to have a meteoric origin, is chiefly confined to the southern hemisphere, as in the deposits of South Africa, Brazil and Australia.

Exception may be taken to all such hypotheses, on the ground that the many meteoric stones which have been submitted to careful analysis have not thrown much light on this important question. In a few instances, minute diamonds have been found in meteorites, but no analytical scrutiny has revealed to us any of the rare earths, with the exception of one case, where the present writer found traces of yttria in the Alfianello meteorite, the proportion being

about one part in one hundred thousand. Yet we must remember that meteorites falling in many extensive regions of the earth have remained unexamined, and that a majority of such arrivals have fallen into the sea; and, moreover, the period of time during which the protyl was integrating into the rare elements might have been not only of limited duration but completed long before the commencement of geological epochs. If, as shown in my "Genesis of the Elements," they have been formed by a series of progressive condensations of the protyl, whilst the initial energy, analogous to decrease of temperature, of the original "fire-mist," was gradually declining, we should expect that the elements generated in different regions of the universe would not be identical. According to the best observations, the spectra of those stars which give out a purely white light and are supposed to be the hottest, are the simplest; their chief constituent being hydrogen. Others, such as our sun, of a yellow color and a less degree of brilliance, have more complex spectra.

It must be remembered that we have by no means discovered and identified all the elementary bodies existing within our reach. A remarkable feature of some of the less known elements is the very slight difference between the properties of the different members of the group. To almost every known chemical test they are identical in their behaviour, and the task of deciding whether a given substance is a new element or a mixture of two or more recognized bodies is one in which mistakes have been made by chemists of the highest eminence.

To separate such closely allied elements as are some of the rare earths may well tax the highest resources of chemical science, but it is a slightly less difficult undertaking to detect the presence of any given body in the presence of other allied bodies. For purposes of detection the spectroscope is, without doubt, the most searching instrument at the command of scientific men. It is a key for unlocking some of the profoundest mysteries of the earth and the celestial bodies; the astronomer, the physicist, the chemist, the

biologist, all find it a sure guide. There are various means in which it can be used with advantage. For some elements the absorption spectra are characteristic. When a beam of white light is examined in the spectroscope, it is fanned out into the well known prismatic spectrum. If now a solution of certain elements—didymium, samarium, erbium, thulium, holmium—is interposed in the path of the beam of light, portions of the spectrum will be blotted out and the ordinary series of colors will be broken up by numerous black bands and sharp lines. As each of the above mentioned elements has a special system of dark lines of its own, it is not difficult for an experienced spectroscopist to recognize the presence of either of these elements from an examination of the absorption spectra, even when present in complicated admixture.

Another method, more universally applicable, but vastly more difficult than the former, is to produce what is called the dark spectrum of the element. The spark produced by an induction coil, intensified by the intercalation of a Leyden jar, volatilizes and renders incandescent minute portions of any substance submitted to its action, whether it be solid, liquid, or gaseous. Every element gives a special system of bright lines, forming its characteristic "spark spectrum." Some of these spectra are extremely complicated, comprising hundreds of lines, and when mixtures are being dealt with, the accurate mapping of all the lines and their allocation to their own special element is a matter tedious and difficult in the highest degree.

For detecting a large group of the rare elements a third system of spectroscopy—that of the examination of their phosphorescent spectra—is preëminently the best. It would extend the limits of this article to too great a length were the method of inducing phosphorescence in the rare earths to be entered on in detail. Suffice it to say that when a high tension electric current is passed over certain of the rare earths, especially those of the yttria and samaria groups, sealed in a glass tube, and the enclosed air is exhausted to a high degree, they shine with a bright phos-

phorescent light, and when this light is examined in the spectroscope it is seen to consist of discontinuous bands and lines of light. Experience extending over many years has shown that, as in the other cases, each element of these groups has a special series of lines and bands of its own, and by their careful interpretation, information, not only as to the separate elements present, but as to the more intimate constitution of the so-called elements themselves, can be obtained. More recently the indications of the phosphorescent spectra have been registered by photography in a specially devised spectograph, in which every part of the optical train—vacuum tube, condensers, lenses, prisms—is of quartz, while the jaws of the slit are made of the edges of accurately ground quartz prisms, and the photographic plate is curved to the proper arc to receive the different rays of the spectrum, each at its own focus. By this means the eye observations are enormously extended, and the powers of the spectroscope are correspondingly increased. With yttrium, for instance, different groups and systems of lines are seen to fade out or intensify according to the chemical operation to which the element has been subjected, and it has been satisfactorily shown that, between the rank of elements and the original substratum of protyl, an intermediate rank of "meta-elements" will have to be admitted.

We here recur to the question, What is an element? How and where are we to draw the line? There seem to be different grades in the elemental hierarchy. Chlorine and bromine differ from each other much less widely than does either of them from oxygen, potassium or iron. Nickel and cobalt are still closer to each other, and had the compounds of these two elements been alike in color instead of being almost mutually complementary, their distinct character might scarcely yet have passed beyond the sphere of controversy. But if we come to the elements of the "rare earths," we no longer stand on firm ground. The dividing line, *e. g.*, between neodymium and praseodymium depends on no broad principles. And how is it then with the elemental or rather meta-elemental bodies whose existence has

been recently made known by Krüss and Nilson? Here it becomes scarcely possible to draw any definite line. The different groups shade off so imperceptibly into each other that we cannot find a definite boundary. Slight chemical differences are entitled to be admitted, and also slight physical differences, but we are soon confronted with the question, What is chemical and what is physical? If we find in one solution that a nascent amorphous precipitate has a tendency to fall down more readily than in another solution, is not that a physical difference? May we not call colored reactions depending, perhaps, on the amount of some particular acid present, and varying according to the solvent employed, and the concentration of the solution, chemical differences? Can we grant elemental rank to one substance which differs from another by decided color reactions and spectroscopic behaviour, and still refuse it to another substance whose claim is a slight, though decided, difference—in excess or in deficiency—of basic character? A new group—a sort of suspense group—seems to be the most reasonable means of avoiding the difficulty, and hence my suggestion of meta-elements, into which it appears likely that many of the well-recognized elements are resolvable, has been generally accepted by chemists. We are, however, here dealing with some of the most difficult problems that a man of science can have submitted to him, and much research will have to be gone through, and a long time must be spent, before a really new chemistry of elements and meta-elements can be constituted.

AUTOBIOGRAPHICAL NOTES.

By Prof. Richard A. Proctor.

[We are fortunate in being able to give, through the courtesy of Miss Mary Proctor, the following highly interesting details of the life history of the late distinguished astronomer, written by himself in 1886, and left among his posthumous papers. Miss Proctor writes as follows:

"To bring the abstruse science of astronomy within the reach of all, was the aim and ambition of my father, the late Richard A. Proctor, and it may prove interesting to trace the growth of his work. I have before me a few pages of his autobiography, telling of his earlier attempts, which show clearly enough the difficulties with which he had to contend in the earlier part of his career. But his efforts were undoubtedly crowned with success, for by means of his popular lectures and writings on astronomy he brought this abstruse science within the reach of all. He revealed to those who had not time or inclination for scientific research the wonders of the depths of space and the possibilities of life in other worlds than ours. His popular lectures on astronomy were of great value to many who, unable to give the time to scientific study, were enabled in this way to gain, at least, a general idea of modern scientific methods and results. He wrote, in all, fifty-seven books on astronomy, his last work, "Old and New Astronomy," being the result of twenty years' preparation and study. With regard to this book he wrote as follows, in the New York *Tribune:* 'I intend to write a systematic work on astronomy, putting into a final form the results of my studies, now scattered through my essays, lectures, and magazine articles.' This last and most important work, to which he had given his best energies, was unfinished at his death, but as he left considerable material for the remaining chapters, the book was completed by his friend, Arthur Cowper Banyard."]

A few months after leaving Cambridge, in my quiet home at Ayr, free from all anxieties about maintenance (for I had inherited ample means), I began in a very modest and quiet way the study of some astronomical matters, to which my attention had been attracted by two books picked up at a book stall in Glasgow. Those books were, Nichol's "Architecture of the Heavens," and Mitchell's "Popular Astronomy." I bought a telescope, which I mounted after a fashion devised by myself—a plan pictured in my little "Half Hours with the Stars," and subsequently in "Chamber's Astronomy," with all due acknowledgment. With this small telescope I fed my growing zeal for astronomical

study, until something like that special interest in the study which I have felt now for about a quarter of a century began to arise in me.

In the meantime my first born was attracting an amount of attention from me which will probably seem absurd to fathers whose daily vocations take them much from the family circle—at least during the hours when the little ones are at large. As I noted his growing intelligence, and as simultaneously my love for science increased, I became possessed of the desire to fit myself to be his teacher in astronomy and mathematics during those earlier years of life, which, in my own case, had passed under the stupid system of cramming the dry husks of knowledge then pursued, and I fear pursued still, at colleges and schools. But as I studied with this chief end in view, and content to hope that I could teach him the elements of knowledge, there came upon me frequently a desire to communicate to others matters of interest which I had noticed during my studies, and which I had found either insufficiently described or not noticed at all in the books. Again and again I attempted the task of exposition, but I was always dissatisfied with what I wrote. I still possess a great heap of papers which I wrote for my boy; but the papers I wrote for publication I systematically destroyed within a few weeks of writing them, because I found on reading them over that they were either wanting in clearness or imperfect in style and manner. The first article I ever ventured to forward to an editor, as less unsatisfactory than those I had thus far written, was an article on "The Colors of Double Stars." It will give an idea of the difficulty with which I then wrote on scientific matters for popular reading, to state that I was engaged more than six weeks over that short article of nine pages. Often I would not complete more than four or five lines in a day with which I was satisfied, so that, as I canceled all else, my work went on very slowly indeed.

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In the meantime, however, the special reason I had for beginning my work had passed away, and I learned—sadly, as most of us learn such lessons—to find, in work begun for one very dear to me, the best balm for a very deep wound. I was losing health and strength, after the death of my eldest son, and I was strongly advised by the doctor to interest myself in some work which would occupy me for at least a year, that a large part of each day's thought and study should be devoted to that task. The task I undertook, in response to this much-needed suggestion, was the preparation for a treatise on "Saturn and its System." The work went on busily, though not cheerfully, for more than a year. The work I first undertook when my "Saturn" had been safely launched was a "Star-atlas," and later on the "Handbook of the Stars." The book was ready for the press when its publication was interrupted by a circumstance which came near bringing my scientific work to an abrupt conclusion.

Toward the end of May, 1866, a bank called the New Zealand Banking Corporation, in which the bulk of my property had been invested, collapsed suddenly and completely. It was one of the banks brought to ruin by the failure of the great discounting house of Overend, Gurney and Company, the famous "Corner House." I was the second largest shareholder in that unfortunate New Zealand Banking Corporation, and the largeness of my holding meant now no longer property, but largeness of liability. Not to enter into the details of a disastrous business, the full settlement of which occupied two or three years, I may simply note, that in June, 1866, I left my pleasant home, near Plymouth, to enter on the struggle of life—a struggle almost for life—in London; and when the balance of my property had been disposed of, to meet, as far as the proceeds would go, my share of the bank's liability, I was left with an uncleared liability of about thirteen thousand pounds (sixty-six thousand dollars), and no property whatever. Thus I found myself beginning that struggle under conditions much more trying than those which had often

moved my sympathies in reading the records of literary beginnings in London. A lad of about eighteen, coming to London, with half a crown perhaps in his pocket, and creative powers in poetry and fiction or the like as his literary capital, has, doubtless, an arduous task before him, and many who have begun literary life under such conditions have lost heart, or have been defeated despite their most earnest efforts. I was not a lad of eighteen, but had already entered my thirtieth year. I had not half a crown in my pocket, but less than nothing; and I had not for literary capital creative powers in a subject in which all men take interest, but simply a power of generalization in a subject regarded as abstruse, with a possible chance of learning how, by special care in exposition, to interest a small section of the general public in the popular study of that subject. To add to my anxieties, I had not only myself, but a family of five persons in all, to maintain out of the hitherto untried resources of scientific literature. The taste I had for scientific research, as well as scientific exposition, was against me, for scientific research is not remunerative. I may say, indeed, that, so far as I knew, scientific exposition was not likely to be remunerative either; and I had no particular taste for it, as my slow progress with my essay on the "Double Stars" had shown. But I may say, that the morning after I heard of the bank's failure, and from that day onward, I did not take one day's holiday from the work which I found essential for my family's maintenance. I found science writing slow and unprofitable work. I was as yet little known to the editors of magazines and journals, and for success in popular writing on science one must be, in some degree, known, since few editors are sufficiently versed in scientific matters to be able to distinguish between correct science and finely-worded ignorance.

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In the autumn of 1867, when I had at last entered definitely on literary work, I passed through experiences enough

to age a man ten years in as many weeks. Sickness and death in the family, sorrows and disappointments, which need not here be touched on, fell upon me. But the darkest hour comes before dawn; and soon after this dismal time the dawn began. Since that time, though I have had to work hard, I have not been troubled, as I had long been before, by the sickening blows of repeated disappointments. Of work which tells none need complain; nay, it is a blessing; but work thrown away tries the strongest and most enduring.

GENIUS: THE MODEL FOR EDUCATIONAL METHODS.

By William George Jordan.[1]

Genius has ever been looked upon as abnormal, erratic, and beyond all ordinary humanity. It has been considered a marvelous power, with no more relation to ordinary man than a fairy. It is commonly spoken of as above all law, as even a law unto itself. Genius is not above law, it represents but perfect, unconscious obedience to law. The genius is simply the man in whom nature has succeeded, in some line. Genius should be accepted as the model for education, the incarnate revelation of nature's perfect working in some line. The psychology of genius should be the psychology of education, and to give the large lines of this thought is the object of this paper. Mental Training by analysis, law, and analogy takes genius as its aim, its inspiration, its revelation. The philosophy of Frœbel is based on a study of the child-mind in all its phases, the instinctive working of nature unperverted by "education." Frœbelism is based on the study of spontaneous tendencies and methods, the mere rudimentary dawnings of activity,

[1] Author of "Mental Training: A Remedy for Education," in the October, 1894, number of The New Science Review, which outlined a plan of training the mind, based on analysis, law and analogy.

while Mental Training studies all these phases and tendencies as they are magnified, and finds supreme development in the mind of genius. These two educational methods, studying the subject from extreme opposite views, are essentially in harmony in idea and general method. The kindergarten philosophy, excellent as it is, is limited in its term; it is cut only in children's sizes. What is needed for true education is a training that will begin where the kindergarten work ends, a system that can be carried not merely through school and college, but through all life, and such a system is Mental Training.

The relation of genius and education upon which our thought is based is given in these definitions. Education, in any line, is conscious training of mind or body to act unconsciously. When this action or obedience is true, perfect, instant, and unconscious, it is genius in that line. A student of music, a pianist, may be taken as an example. Here the ability consists of two parts—the power of the mind to read the notes and understand their values and relations, and the power of the fingers to respond to the findings of the mind, and to express its discovery in movements that appear to the ear as sounds. His musical education is this twofold training—discovery of the law of music by the mind, and obedience to this law by the fingers. This is but analysis by the mind, and synthesis, or the expression of the analysis, by the fingers. At first, progress is slow, stiff, laborious, and uncomfortably conscious. As the training continues, day by day, the mind feels less and less the intenseness of conscious obedience to the laws it discovers, and the fingers act easier, freer, and with less conscious effort. This is commonly expressed by the phrase "force of habit," but force of habit is itself but the unconscious action resulting from conscious training. Suppose this obedience of our pianist to the laws of mind and fingers be true, instant, perfect and unconscious, we have then in him this ability in its supreme form; it shows what is termed the "divine spark" of a Rubenstein, and this player is a genius.

Every step too, in this progress, is one step nearer genius. It may be said that "a brilliant pianist, however carefully he may study and think, at last reaches a point of ultimate perfection, yet far removed from the genius of a Rubenstein." This is true, yet the particular point varies; it is relative; it represents what he considers his maximum obedience to law. Rubenstein, by force of genius, goes beyond this, but he does so only by obeying the law still further. It is no wild eccentric departure from law, but simply continued and developed obedience. The point here to be made is that genius, this "divine spark," as it is called, is but a simple evolution of aptness. The progressive stages in the evolution may be roughly designated as aptness, cleverness, talent, great talent, genius; each being but an evolution, a perfecting of the power preceding, each being but a more perfect and less conscious obedience to law. So it is in all lines of human effort. The child who first looks with wondering eyes at a star is at one end of the line, Tycho Brahe, Copernicus, Galileo, Kepler, Leverrier, Newton and other astronomers are further on, and that line melts into the infinite and finds its end and eternal perfection in God. But we are all on one line. All men have within them the same elements, mental, moral and physical, and all obey the same laws; the difference between individuals is only in the varying degrees of development of those elements. The four-leaved clover may be looked at as the genius among clovers, but under the searching eye of the microscope every three-leaved clover reveals the germ, the rudiment of the fourth leaf, that needs but development. So it is in the mental world. There is no monopoly on genius. Genius is held by no syndicate or trust of specially favored men, singled out by their Creator for special divine favor, subject to special laws for themselves alone. Genius in any line is but wondrous development of elements present in all men; it is marvelous, developed, unconscious obedience to law that we may discover and apply for ourselves as the basis of all true education.

XUM

We have not here space to enter into a study of the physical, physiologic, and psychic causes working in unity with heredity and environment which make the genealogy of factors that brings the genius to light. These we can touch on only suggestively in passing, but when some great genius appears before a wondering world like Venus emerging from the sea, the same law has been in action, as in every other individual. If the whole life, every thought, every motion, every act, in mind and body of any genius in the world were to be made visible and luminant to us, if we could then see in the same relentless totality all the life of all his ancestors, with the power of the full knowledge of perfect law to interpret all and to see every trifle in its true relation, we must see *that* genius as normal and regular a product of the working of law as are we ourselves. Through heredity, and the vitalizing by need and opportunity and other powerful favoring conditions, *that* genius in his unconscious obedience to law is the natural and necessary outcome of the conditions. It is an obedience to law that, in proportion to our powers, may be as a million to one, but he has only the same elements as we, and obeys precisely the same laws, the differences between us being only in development. We are on the same line as he, we progress in exactly the same manner, differing only in degree. If it were not so, every man must then be a separate and distinct creation of the Almighty.

Any system of education or of mental training that does not look at genius in any line as simply the perfect and unconscious obedience to law for that effect, must be wrong. If every genius be an exception, if it be a special gift, a special God-given power as we say, then too must be every talent, every aptness; then all minds become special, each a law unto itself, and all basis of unity, of uniformity, of system of training, is lost and impossible. Education in any line of life—art, music, oratory, drama, conversation, any power—must look *ever* at genius in that line as its aim, its end, its source of light, its revelation of the perfect working of law. It is often claimed that genius is a mar-

velous power that instantly forces universal recognition. The history of all time proves this view to be false. The world takes at least two generations of perspective to properly appreciate a genius. The world thinks slowly, and often requires decades of cerebration to reach and realize the thoughts of one of its boldest thinkers. Men take the greatest mind in any sphere of mental effort in any age of the world, the supreme power at that time, and then coolly ask: "If genius be not a special gift, a wonderful divine spark, why have we no equal to this man?" It is simply because they select the greatest, and he cannot be surpassed in his line. If he were surpassed he would no longer be greatest, the new light would be the genius, the old one merely talent. "Genius eclipsed or surpassed ceases to be genius." So, practically, says the world. Philip II. of Macedon, was a great military genius, Alexander, his son, surpassed him, then Alexander became the genius and Philip but a "great military leader and the father of Alexander the Great." So did Shakespeare dwarf all his contemporaries.

The most common and specious argument that is brought in favor of what may be termed "the miracle conception" of genius, is that "so many of the mighty masters of the world came from parents who betrayed no evidence of the power." But it is not necessary, for instance, that the parents of an artist-genius should paint. A genius, like all other men, is the child not only of heredity but also of environment. He may have received through heredity but a quick eye, and an appreciation of sunsets and the beauty of nature's common-place. This mere seed of ability placed in a new, warm, generating environment, through years of development, flowered into genius. A French scientist recently investigated the Hindoo mango trick, in which a seed planted in the presence of the audience grew within the space of an hour to a tree a foot high. He found the Fakirs always used a prepared earth, which he at length discovered was taken from ant-hills. He found this earth was charged with formic

acid, which had the power of bursting the seed integument and of wondrously quickening the growth of the germ within. A quickening environment acts in the same way in mental growth. An intense crucial moment in the life of an individual may focus and reveal characteristics hitherto unknown, unsuspected. The coward of a life-time becomes the hero that leads armies. Accept the analogy, and this mystery of genius becomes the revelation of the process working in all life. The simple hearted, sensitive gentleness, oneness of purpose, honesty and broad humanity that in Nancy Hanks remained obscure and unnoted, illuminated the whole world with the torch of freedom held in the hand of Abraham Lincoln, her son.

But genius, it is claimed, is "original." They say the word "original" in a large liberal way as if they had solved the question—"Genius is bold, original, soaring above all others, dependent on no others." But Shakespeare, the most original of all dramatists, was most dependent—strengthening, vivifying and individualizing whole acts and plays of others. This question of originality is in reality a paradoxic one. If a man take from one source he is a copyist; if from two, he is less so; if from ten, the world begins to lose count of sources; if from a thousand sources, we bow the head and bend the knee and whisper "Here is an original man." Originality is but the result of an infinity of impressions that have percolated through an individuality, they changing it as it changes them. The distinguishing characteristic of genius is a wonderful sensitiveness of mind, a quickness to assimilate impressions from every source and permeate them thoroughly with his own individuality. Genius is ever most *dependent* for him, the whole world is his garden, and his individuality the hive. Develop individuality and you develop originality; you then make the mind expand, and grow naturally. The schools and colleges of to-day, our modern knowledge-factories, pervert individuality into the petrified uniformity of pressed bricks.

Genius, say some, is but a capacity for hard work. This is not a whole truth; there must be work in accordance

with *law*. The miner who digs for gold on the seashore will never find it, though he dig ever so laboriously; but if he study gold and the geologic strata in which it lives, he has begun to put himself into harmony with law. Mere work, unless properly directed, is like riding a hobby-horse, there is energy and motion, but no progress.

There is a theory held by scientists that genius comes from disease. Disease, insanity, depravity and other failings often do occur as consequents due to over-concentration or misuse of powers, but they do not create genius any more than the vultures of the plains create the carcass upon which they feed. The genius too, being of finer mental material, is more likely to show a flaw, as Dresden china reveals a mar not noticeable in a red-clay flower-pot. In support of the disease theory, the most insignificant, common-place ailments of ordinary humanity, when found in genius, are magnified and exaggerated. The weaknesses thus pointed out are, it is worth noting, usually shown in the part of mind or of body where the genius was not exercised.

Let us now study for a moment the great basic elements, the ever-present characteristics that, masquerading under a thousand disguises, are the foundation of all genius. We are here studying the mental anatomy of genius. Then we may test our outline of Mental Training to see its relation to the revelation. The great essential factor in genius is imagination. Imagination in its simplest phase is but mental imaging—and this imaging can be expressed only through one or more of the senses. Genius always implies a special sense development. The wonderful perfecting of the sense may come to an individual through heredity, without any seeming effort on his part, yet it is a power that can be developed in some degree, in every one in the world, from the idiot to the genius. And this development does not merely quicken the mind but it builds up the very brain itself. The same sense development may, in different individuals, be the basis of distinctly different kinds of genius. The wondrous development of the sense of sight is shown in a marvelous visual memory, a wonderful power of vivid

imaging of what may appeal to the eye. Geniuses that seem to have nothing in common may be but different manifestations of the perfection of this power. It may be shown in the genius of the artist who makes his canvas breathe with some sublime conception; the novelist, with a quick eye for the essentials of a summer scene; the poet, whose fairy wand to create new worlds before our eyes is his pen; the chess player, who blindfolded can play a number of games simultaneously; the memory prodigy, who visualizes whole pages at a glance; the orator, who holds his audience captive by the magic of his imagery; the statesman, who never forgets a face—these, and a hundred other phases of power, varying from mere cleverness to unquestioned genius, are basically manifestations of the same sense development, expressed through different individualities and quickened from a different standpoint. So a wondrous aural memory may be shown in the singer, the poet, the musician, the orator, and in other individuals. The same line of reasoning can be carried into the other senses.

This sense development, in its perfection, is one of nature's methods for producing her master-pieces, and so it should be recognized as the first duty of education to every individual. Mental Training by analysis, law and analogy, does recognize it, and seeks to develop not only one of the senses, but, to a degree, each and every one, and perfects the individual in imaging. This power from merely imaging the concrete can be developed to a marvelous ability to image the abstract, to "think in phenomena."

But in genius the mere sense development in itself is not enough. The wonderful quickening in impression brings vivid images to memory; there they are worked over, permeated by the individuality, and thence expressed in some objective form. If this threefold process be seen as a part of the processes of genius, it should be an essential of all true education. Mental Training exercises the individual in this threefold process, in instance after instance, example after example, week after week, until it becomes automatic, and each new impression, through the acting of unconscious cerebration,

is classified as naturally, easily, and spontaneously as the blood circulates through the body.

Every genius is quick in analysis in his line, he is quick to grasp the why, the reason, the law behind one instance, and to project it into new fields by analogy. Of course, it is not essential that he be conscious of process. It is but a natural process of all minds; in his, working in automatic perfection; in most minds, perverted or killed by false education. Mental Training based on these three words, analysis, law and analogy, brings the mind back to the normal, exercises and develops it from conscious obedience to unconscious or automatic action. The genius is constantly preparing for instant use, analyzing, classifying, and storing for instant readiness. For years Napoleon was living in miniature the battles he was to fight, analyzing strategic moves and positions, and training his mind to thus grasp a new situation on the instant. Von Moltke studied the military topography of all Europe, and with marvelous foresight *thought* out how to win. His victory was no triumph of mere fortune or special inspiration. It was but the logical outcome of his trained mind, and a trained mind ever lights the torch of its own inspiration. Leonardo da Vinci always carried in his girdle his sketch-book, in his walks in Florence, constantly looking for picturesque faces. "In the silence of the night," he would counsel himself, "recall the ideas of the things you have studied. Design in your spirit the contours and outlines of the figures you have seen during the day."

Often, in life, we see some wondrous vitalizing of latent possibilities, some supreme manifestation of power, and we say "That is genius, it is a power beyond him; surely he is inspired." It is but the flowering of a process of years. The century-plant for many years lays up nourishment in its large, succulent leaves. Then, after from fifteen to seventy years of preparation, the time for flowering comes; all the hidden vitalities are drawn upon; the flower-stalk shoots up with marvelous rapidity, and in a few weeks the countless blossoms have opened. So genius is constantly pre-

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paring, classifying, individualizing, ready for full expression when needed. This is not a wasteful, tiresome process, it soon becomes automatic. The pure, concentrated activity, with no wasting effort, is no drain on mental vitality. It is worry, fear, and the ghosts of after-thoughts that weaken the mind; but in well-directed thinking the mind finds strength and life. Constant preparation for instant use is, therefore, one of the watch-words of Mental Training.

Will-power, the great unifier of all mental energies, is the Napoleonic power of mind that brings the thousands of memories, hopes, fears, longings, and aims into a single mental army, drilled, united, and in perfect harmony, eager to conquer and attain what that will-power commands. If man's will-power be weak, he is but a chip on the great tide of humanity; if it be strong, man towers into the full magnificence of his possibilities, pervaded by the very breath of omnipotence. Concentration, clearness of thinking, liberality of mind, system and economy of energy—these are all qualities strong in genius, and, as basic elements of power, are part of the constant exercises in Mental Training. Such an education would take less time of the individual than the ten to twenty years of servitude with hard labor now required in the education of to-day. The list of studies would be greatly reduced, and the quickened mind from one study would make another easier. It does not do so. A student to-day does not necessarily learn his history better because of his study in botany. If education were what it should be, he would learn it better. One cannot but recognize, as was suggested in my earlier paper, the wonderful progress made by educators in the last few decades, but a truer expression is needed of their recognition of their duties to the *individual*, in preparing him for life.

Mental Training fully recognizes the differences in mental capital of individuals, it considers all the variations in tendencies and desires and needs. It does not seek to make men equal. It but seeks to train the mind of the individual to do its best in whatever be its activity or sphere of work.

It quickens all faculties, cuts off wasted energy, lost motion, and makes all parts of the mind alert, constantly active and trained to instant readiness. It sensitizes the mind as a photographic plate is sensitized; then the mere "taking" is without effort. It takes genius, as its revelation of the perfection of mental working, in all its phases, unified in a comprehensive educational system. The analogy between Mental Training and physical and moral training is perfect and complete. Sandow might be taken as the physical genius of the age; and, therefore, the revelation of the process for proper muscular development. It is not necessary or wise to go to the full extent that he has gone, but it is the revelation of *process*. The same is true in the moral world. Christianity puts forth Christ as the perfection of moral law, existing in perfection only in Him. In true reverence, then, He may be called "the genius of moral law." Though man cannot attain this genius, every step in the obedience is one step nearer the perfection of Christ. It may be said that geniuses in the same line differ materially in their methods; this is not true. Careful analysis shows they are in basis the same; different in individuality and manifestation.

While giving the individual the general training, in this article but merely suggested, every study should be taught, so far as possible, from this same point of view. In the psychic methods of the mathematic prodigies is the revelation of the perfect method of studying mathematics: the method of scientific observation that in a Darwin finds its crowning in his great discovery, should be the process, epitomized and minified, present in all our observation; the method of the great linguists who assimilate new languages without effort is but nature telling us, in the success of genius, what is the best way to study language. Before teaching drawing, arbitrarily and perfunctorily, as mere imitation, let us begin to develop the artist eye by quickening the visual imagination. The psychic mechanism of the man who learns words correctly without effort is the revelation of the *how* to teach spelling in all cases. And so for all other studies. We really know much more about what

these processes are than we have applied. Psychology is far in advance of education.

That this is the ideal education is shown in the fact that the great men of the world either failed in school or made no great progress; and that infant prodigies subjected to our education lost or weakened in their power. This training does not check the individual development in any one phase, the special turn of its ability, it but raises the average of the whole mind, quickens all the faculties and makes all tributary and strengthening to the part that is supreme. Darwin, in his latter years, lost all appreciation of poetry, and found music absolutely distasteful. But a few minutes weekly exercise of this part of mind would have kept it active and alert, and been a source of new mental strength, relaxation and inspiration; it would have been a safety-valve to his over-concentration. It is not necessary to teach all students all studies, or to teach them equally; but wherever they *are* taught it should be in accordance with the methods that genius shows in their perfection.

Mental Training reveals to the individual—himself. It shows him his weakness and inability, and how he may correct them; it shows him his powers and possibilities, and how he may develop and realize them. Man is placed in the world as a possibility, not as a finality. Man has two creators—his God and himself. He must not fall prostrate and helpless before his heredity, nor overlook what he may do by his own training. Mental Training will do much more than is commonly believed to lessen the differences between those born with strong powers through heredity, and those in whom these powers are so faint as to seem hardly even a germ of ability. A. R. Wallace recently pointed out that the wonderful skill shown by the North American Indians in following the trail, by indications of sight, scent and hearing, imperceptible to ordinary powers—a skill developed in them through generations—is equaled and even excelled by white trappers in a very short period of time. So it is with every power, mental, physical or moral. We can coöperate with nature in perfecting any of our pos-

sibilities by looking more closely into genius to see nature's messages of hope, direction and revelation, and to feel that the law that produces nature's masterpieces will be proportionately true with us, if we obey it.

WHERE THE STEAMBOAT WAS BORN.

By Maggie Symington.

In the valley of the Nith, in Dumfriesshire, there is an old burgh town called Sanquhar, surrounded by hills, in the midst of a neighborhood rich in the history of those famous Covenanters who were persecuted so bitterly in the time of Charles II.

Somewhere about two miles to the south of this old town a country road winds up among the hills which slope down to the edge of the stream of the Mennock, and at many parts seem to close in so abruptly that you think an insuperable barrier is before you. By pushing onward, however, the path opens and the ascent becomes more and more toilsome. So high and wild is this path of Mennock that in winter it is frequently blocked up with snow, and the inhabitants of the two mining villages are quite cut off from their fellows down below, for no vehicle can get through the drifts, nor any foot-passenger. Then, for months, the only communication with the outside world for the miners is by telegraph. In summer the scenery is as lovely as that of any Alpine region.

A few years ago, some one who had traveled much went up this path to Wanlockhead, and was very much struck with its wonderful resemblance to the road which leads up from Joppa to Jerusalem. "For miles," says a local historian who knows it well, "no human dwelling has been visible, and no sound, save that of the rushing stream, the bleating sheep, the whirr of the grouse or black-cock as, on strong wing, he sweeps across the glen and drops out of sight among the deep heather which covers the mountain side.

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Then, suddenly and unexpectedly, the village of Wanlockhead comes in sight. The existence of a village in such an out-of-the-world region is due to the mineral wealth of the surrounding hills which, though black and barren on the surface, and sustaining only a few sheep, contain within their bowels rich deposits of lead."

Now, it was in this very village of Wanlockhead that the steamboat was born. And here, in the companion village of Leadhills, only three years ago, a monument was erected to the memory of the inventor. "It is curious," says the same local historian, "that it (the steamboat) should have originated in perhaps the most inland place in all Scotland."

It was in the "Auld Manse" of Wanlockhead that two brothers lived, one of whom planned and perfected the first steamboat that ever plowed its way across the water. His name was William Symington, and he was a member of my own family, though not a direct ancestor. There is but one family of the name, and they are "Symingtons of that ilk," *i. e.*, "Symingtons of Symington" in the bordering county of Lanark.

Think of those clever Symington boys inventing "a steam carriage" that was made to run across the floor of one of the rooms behind those quiet windows, and was really and truly the precursor of the steamboat.

An old man, one John Black, years afterward, when the Caledonian Railway was opened, was asked to go to Elvanfoot to see the wonderful new steam-carriage, and answered: "I need na traval sae far for sic a purpose, for I hae seen a steam-carriage mony a year syne (since) rinnin' in the auld Manse o' Wanlockhead." Over the kitchen floor, so it was said, and it was described to be "as like an ordinary sized kist (chest) as possible."

In the year 1785 a Mr. Miller, of Dalswinton, engaged a young man as tutor in his family whose name was James Taylor. He came from the village of Leadhills, and had received a liberal education in the University of Edinburgh. Mr. Miller was a man of speculative turn of mind, and at that time he was engaged upon a series of experiments on ship-

ping. He had designed paddle-wheels as a motive power. These were turned by a capstan which kept four men hard at work, and it did not seem likely that such a laborious method as this would ever be of much use if applied to large vessels, or be workable for long voyages.

At his wit's end, Mr. Miller asked his tutor to try and think of something more suitable as a motor. James Taylor was an old friend and schoolfellow of William Symington, and, while he lived in the neighboring village of Leadhills, had, there is no doubt, been frequently at the auld Manse of Wanlockhead where the Symingtons lived. Perhaps he too had seen that funny steam-carriage "running over the old kitchen floor" with intense interest and delight, for what youth is there who would not have manifested the keenest joy in such a production by a companion and schoolfellow?

Anyway, his instant suggestion to Mr. Miller was that he should get a steam engine to run his paddles for him. Miller was incredulous, he did not think such a thing possible; but James Taylor persisted. Most likely he had the best of reasons for his suggestion and also for persisting in it; he had actually seen the thing at work, and knew something of what it could do.

It is not to be wondered at that in a short time he succeeded in convincing Mr. Miller, and it was decided that a trial should be made. It was necessary to get the services of a practical engineer. Taylor at once turned to the Symington brothers. Who so likely as they to see the way out of the difficulty? He set off at once for the auld Manse, and the Symingtons and he laid their heads together. The thing could be done, it was decided.

To make a long story short, a small engine was designed and constructed. An old smith, one John Hutchinson, is said to have contributed something toward perfecting the engine. He was engaged to help in the work of constructing it. A hitch occurred with some part of the machine that hindered its working, and perplexed the enthusiastic inventors.

And here a little hitch occurs also in the thread of my story, this part of it having two versions:

One states that young Symington—he must then have been about twenty-one or twenty-two years of age—was walking with old John across the Stake Moss one Sunday morning, discussing this difficulty, when an idea flashed into the old man's mind, and he immediately communicated it to the younger one by making a rough drawing of it on the road. On their return, it was worked out in a practical way in the smithy, one saying to the other, "The better the day, the better the deed."

The other version says that it was as old John was lying in his bed that Sunday morning that light broke upon his mind, and that he drew the plan first on his own hearth-stone, and afterward to Symington as they were out walking.

At any rate, some way between the two, the difficulty was solved, and nothing now hindered the practical application of the steam-motor to Mr. Miller's paddles.

So the idea grew and was adopted.

On the 14th of October, in the year 1788, the trial trip of the first steamboat was made on Dalswinton Loch. On board the little craft, as she sped over the waves at the then astonishing rate of five miles an hour, was a truly notable company. There was Alexander Nasmyth, a famous artist, and father of James Nasmyth the inventor of the steam hammer; there was Henry Brougham, afterward Lord Chancellor of England; and Robert Burns, the people's poet, who certainly ought to have chronicled this world-famous trip in verse. Of course Mr. Miller would be there, and James Taylor, and Symington, who was young enough to enjoy the triumph of his ingenuity, and to see visions of glories to follow, which, alas, were never fulfilled in his life-time. He was then just twenty-four years of age.

The vast significance of this event was not then sufficiently understood for it to be immediately followed up. Even thirty years after this successful trial had been made, the engineer, Rennie, wrote to James Watt of the difficulty he had in getting the Admiralty to see the utility of this

invention. On the 30th of May, 1820, he wrote again that the Admiralty had at last decided upon having a steamboat. So Symington lived to see his invention utilized, though what part he had in it, if any, we do not know.

The inscription on the monument, erected to his memory, is:—

WILLIAM SYMINGTON,
THE INVENTOR OF STEAM NAVIGATION.
Born 1764, Died 1831.
Erected
By Public Subscription.

On the face of the monument is the head of Symington in relief; on the back a figure of the first working steamboat, with her name, *The Charlotte Dundas*, 1801.

It is, therefore, a proud distinction which the village of Wanlockhead enjoys, hidden away among the Scotch mountains, in a district where it has been truly said that "almost every mountain, and hillock, and glen, has its own tale to tell—a tale of cruelty and bloodshed," for it is the scene of the persecution of the adherents to the Solemn League and Covenant.

I have spoken of Wanlockhead and Leadhills as mining villages.

The mines here have been worked from a remote period, and belong to the Duke of Buccleuch. The miners are a remarkably intelligent, fine-looking body of men. Their working hours are not long, they get good wages, and due provision is made for their mental culture in the possession of a well-stocked library. There is no public house in either village, so the men are not exposed to the insidious temptation of drink. Their houses are built in the most delightfully irregular fashion, and are cozy and comfortable, consisting of "a but and a ben;" and many of them are furnished with box beds. They have low roofs, which used to be thatched with heather—simple surroundings for the birth of a great invention.

Since that first boat steamed across the little Loch of Dalswinton, what changes have been brought about! International commerce has advanced by leaps and bounds,

America has been brought so near to us that we may almost be said to clasp hands across the water; while those countries to which distance lent a strange halo of romance—India, Australia and the South Seas—are no farther away from us now than America used to be.

Smiles says, in his "Lives of the Engineers," that "long before Fulton, Miller of Dalwinston and Symington had been at work on the invention of the steamboat," their baby steamboat once born, grew and developed under the care of many nurses and teachers; but there can be no doubt that the application of steam to navigation originated with William Symington, and that the true birth-place of the steamboat was the "Auld Manse" of Wanlockhead.

THE ETHER AND ITS FUNCTIONS.

By Prof. George Frazer Fitzgerald.

"All are but parts of one stupendous whole
Whose body nature is, and God the soul."

We often speak of space as being empty. We speak of an empty room when it is quite full of air. We speak of empty space between the stars. From this point of view the first line of the above couplet should run:

"All are but parts of one stupendous *hole*."

When we more carefully consider matters, however, we must concede that this way of speaking does not accurately represent even the popular view of nature. Still less does it represent the view that must be taken by every diligent observer and accurate thinker. In the case of an empty room, everybody acknowledges that it is really full of air, and that to speak of it as empty is not absolutely accurate, though sufficiently so for ordinary purposes. It does not deceive those whom we are speaking to. Quakers even have not objected to use the term. It is defensible on the same plea as stating that one is "Not at home." Neither

statement is verbally accurate, but neither statement deceives, and each is, in consequence, quite legitimate. It does not appear at first sight, however, that there is any obvious way in which it is inaccurate to speak of interstellar space as empty. There are, no doubt, stars and comets and nebulæ and meteors, but between them surely space is empty. And yet even popularly a place is spoken of as "full of light." Surely the space all round the sun is "full of light." Can we, with perfect accuracy, speak of a space as empty which is full of light?

There have been several theories as to the nature of this light that fills space. At one time it was supposed to be some sort of process or feeler that was projected out of people's eyes by which they felt objects. What the cause of day and night can be, seems a serious difficulty to this hypothesis. It would, anyway, justify the suggestion as to the uselessness of the sun which came out by day, though it would hardly explain the usefulness of the moon. This view is not even held by "cranks" nowadays. Light is attributed to the sun, to lamps, to candles, and not to the eyes of the observer. Metaphysicians may ask for the sense in which one can speak of light being present without an observer, but even in this age of skepticism, these very important metaphysical questions have not yet attracted popular attention. We are content to assert that in some sense or another we are justified in speaking of light being due to the sun, or a lamp.

A more recent view was that light was due to small particles emitted by bright bodies. This was a hypothesis with many things to recommend it. In this case it was certainly inaccurate to speak of interstellar space as empty. It must be choke full of these minute particles, hurrying about in all direction at the almost inconceivable rate of one hundred and ninety-two thousand miles a second. Can a space thus actively occupied be accurately described as empty? Even in the shadow of the earth there must be innumerable such particles. The stars are shining there. The earth itself must be emitting immense numbers of

them, for we know that it is cooling all night, and the phenomenon of giving out heat by radiation is essentially the same as that of giving out light by radiation. There are, however, several very serious difficulties in the way of believing this hypothesis. One of the most serious is that one must suppose, upon this hypothesis, that the light travels more quickly in water than in air, while it has been proved by a direct experiment that light travels more slowly in water than in air. There are, in addition, several other difficulties in this hypothesis. Very curious and rather inexplicable fits of easy reflection and easy transmission have to be attributed to these light particles. In order to explain them, Sir Isaac Newton suggested that all space was full of a fluid which in some way caused these inexplicable fits. Such a suggestion almost surrendered all ground for the hypothesis that there were any light particles at all. Once it is conceded that there is a medium filling space, why not attribute light to the vibrations of this medium in the same sort of way as we attribute sound to the vibrations of the air? This is, in fact, the hypothesis now held, and while it explains almost every fact connected with light, there are no known facts necessarily inconsistent with it.

Still, there are people who do not believe in this medium. They seem to think that the sun may act upon us here without any intervening medium. Such people do not appreciate the difficulty in thus explaining what becomes of the action during the eight minutes it takes to reach the earth after it has left the sun. The light takes eight minutes to pass over the intervening space. What is it during these eight minutes? One view was that it existed as small particles traveling with an enormous velocity. This hypothesis is untenable because it does not explain a number of other light effects. The other view is that it exists as some sort of periodic change in structure of an intervening medium which is called a wave of light in the ether. This is consistent with all known phenomena, and no other

hypothesis has as yet been published which has been shown to explain in an intelligible way the phenomena of light.

But there are other phenomena due to the air, for instance, in addition to sound. It has chemical actions, it can blow things about by winds, it can burst strong vessels by its pressure. Are there *no* phenomena due to the ether except light? Surely a medium whose vibrations are so important can hardly fail to possess other properties. Lord Salisbury, no doubt, said in his inaugural address last year, as President of the British Association at Oxford, that the only function of the ether was to undulate. This was a most extraordinary mistake for even a politico-scientist to make. It is one of the glories of British science that by Faraday and Clerk Maxwell a sure foundation has been laid for the theory that electric and magnetic forces are due to the ether. *Its only function is to undulate!* One might as well say the same of the atmosphere or of the waters of the sea. No doubt the undulatory, electric and magnetic properties of the ether require us to suppose a very much simpler nature for the ether than for any known form of ordinary matter. Ordinary matter, with which we are so familiar that we treat its wonders with contempt, is fearfully and wonderfully complex. We cannot hope to explain the innumerable properties of air, for instance, which is quite a simple form of matter compared with most other commonly occurring forms, without attributing to it some very complicated structure. The properties of the ether are so simple that there is every hope that we may be able to explain its properties by attributing to it a simple structure. So far as is known we need only attribute to it the ability to produce electric force and magnetic force in order to explain all the phenomena which can be repeated in any properly equipped laboratory. It is as if we had an invisible bar by means of which we could either push or pull or twist objects at a distance. These are very simple operations, and if they were the only ones that the invisible bar could perform we might very fairly describe it as possessed of very simple properties. No real ordinary matter is so extraordinarily simple as that.

A solid glass bar, for instance, would prevent our pushing our fingers across it; it would bend light that passed through it; it would reflect light from its surface; it would absorb heat; it could be melted if raised sufficiently in temperature; it could be acted upon chemically by hydrofluoric acid; and it would possess innumerable other important properties, so that we could hardly fairly describe it as possessed of very simple properties. Of course no one can prophesy that there may not be found many other important properties of the ether which may show it to be very complicated. The very fact that matter is so complicated, and that ether is so intimately connected with matter, shows that the ether may be very complicated too. At present, however, it seems as if these complications were due to the complex nature of matter, while a comparatively simple ether would suffice to explain all we know.

In the beginning of science it was difficult for people to believe that we were living at the bottom of an ocean of air. Winds were looked upon as subtle entities rather than as movements of the air. The rising of water in pumps was ascribed to an unexplained natural principle of abhorrence of a vacuum. In a similar way we have, until within the last few decades, been content to explain electric and magnetic forces by a natural principle of attraction of electricity and magnetism. As soon, however, as the existence of winds and the rising of water in pumps, the height of the barometer, and the flight of balloons were all explained by the varying pressures in an ocean of gas, people gave up their former obviously unsatisfactory and provisional explanations, and nobody now doubts the theory that these phenomena are all due to a medium whose vibrations constitute sound. All these properties have been shown to be consistent properties of a single medium, and consequently nobody doubts of the existence of this medium. We now are persuaded that we feel this medium when the wind blows us; we see its action when balloons rise; we hear its vibrations in sound. In a similar way electric, magnetic and light phenomena are all consistent properties of a single medium, and consequently

no one should doubt of the existence of this medium. We should feel this medium when a magnet pulls at a piece of iron we hold; we should see its action in a flash of lightning; we should see its vibrations in light.

But, it may be said, nobody has been able to explain these properties? Well, neither has anybody been able to explain the properties of the air. Some of the simpler properties of the air can, no doubt, be explained by supposing it to consist of countless small elastic particles of different sizes and weights jostling one another about. The elasticity of these particles is, however, unexplained, and a great many of their properties, notably the whole series of these chemical properties, are still in that obviously provisional condition of being described as simply *properties* of doing this, that and the other. The electric, magnetic and luminous properties of the ether are very much simpler than the innumerable properties of air, and it is consequently not unreasonable to expect that they will be explained, and it is consequently unreasonable to doubt of the existence of the ether because of its possessing unexplained properties, while we have no doubt of the existence of air though it possesses very many more unexplained properties.

Several directions have been suggested in which we may look for explanations of the simple properties of the ether. It has been suggested that it may consist of particles somewhat like those of a gas, only *very* much smaller and moving about with very much greater rapidity. It has not, however, been fully shown how this hypothesis can explain the electric and magnetic properties of the ether. Others have gone to the opposite extreme, and supposed that the ether may consist of smooth hard particles almost completely filling space, instead of being *very* small compared with their distances apart. These particles are supposed to slide or roll over one another so freely that they practically offer no resistance to matter moving among them. This seems in many ways a rather hopeful direction in which to look for an explanation of the properties of the ether. It has not, however, been fully worked out, though Prof. Hertz has shown, in his

posthumous work, that such a supposition is not inconsistent with what we know of electric and magnetic actions, for he attributes all dynamical actions in nature to actions of this kind. It was the direction in which Clerk Maxwell sought for a dynamical material system that would possess the same sort of properties as he showed that the ether must possess.

All these theories depending on the existence of hard bodies in space, whether like gaseous atoms they have large distances between them, or like the second hypothesis they have small distances between them, labor under the disadvantage of postulating the existence of these hard bodies without offering any explanation of the cause of their hardness, etc. A hypothesis like Lord Kelvin's, that material atoms are vortex rings in a continuous incompressible medium, only postulates the existence of this continuous incompressible medium. From this one postulate, and the hypothesis that its various parts are moving in a variety of ways consistent with the postulate, it can be shown that indestructible atoms could exist. It does not seem impossible that all the complexities of nature may be explicable by this hypothesis. A being living in the midst of an infinite ocean of liquid, which was perfectly transparent and at rest, might never discover its existence, just as mankind lived for generations inside an ocean of air without fully realizing its existence, even though they had plenty of motion in the winds to help them. Such a being might be supposed some day to meet a great whirlpool and thus become suddenly alive to the existence of the medium around him. He would probably, at first, think of the whirlpool as an independent entity. He would, however, ultimately find that its effects extended to all places he could reach. No doubt, at a distance from the whirlpool, its effects would be very small, while near to it its actions would be so tremendous that maybe he could never get quite close to its central core. With this evidence before him, would not such a being be justified in supposing that this active thing was a kind of movement in a medium extending throughout all the space

he could reach? We find a very similar state of affairs near atoms of matter. They have a central region where their action is so intense that we have no evidence that we can penetrate it. Around this and extending throughout space, diminishing in intensity the further we go from this central core, are actions accompanying this atom. Close in there are chemical actions. It may have electrical and magnetic actions. It always has gravitational action at all places, at least as far as the solar system extends. Is it then irrational to suppose that these atoms are themselves really only a particular kind of motion in a medium that fills all space? In order that an incompressible liquid should be able to transmit actions such as gravity, electric and magnetic force, light, etc., it must itself be full of motion. Lord Kelvin has shown that certain kinds of disturbances might be propagated in a manner somewhat similar to light vibrations, by a liquid whose parts were in intense motion. In order that the action may be propagated rapidly, the motion of the liquid must be very intense. The average speed of the motion of its parts must be comparable with that of the propagation of the disturbance. In the case of light propagation this is *very* great. Light goes one hundred and ninety-two thousand miles in a second. The parts of the medium must consequently be moving on the average with a velocity comparable with this. Some years ago, Prof. DeVolson Wood proposed to calculate the average velocity of the parts of the ether in a somewhat similar way. There was, at that time, a very serious objection to this. Prof. Wood was applying the theory of gases to this case. Now, though there is some similarity between the cases, there is an essential difference. Disturbances, such as sound waves, are propagated by the compression and rarefaction of a gas. Light is known to be propagated by some other kind of action, we don't know *exactly* what, but it certainly is *not* by compressions and rarefactions in the ether. It was, consequently, quite illegitimate to apply a calculation which was only known to be true of this kind of motion to quite a different kind of action. Before such a

proceeding would become in any way justifiable, it was necessary to prove that this quite different kind of action could be propagated at all by a medium whose parts were in intense movement, and Prof. Wood had not at that time shown reason for believing this.

If the parts of the medium are really moving at these tremendous speeds, every cubic foot of the medium must have some energy in it. If the medium be at all dense, the energy of its motion will be very large. Each cubic foot might, for instance, be looked upon as a cubical box containing whirling wheels. If the wheels are massive, and whirling with tremendous rapidity, there will be a great deal of energy in the box. If the wheels are very light, there will not be very much energy, even though they are whirling very rapidly. Can we make any estimate as to whether the medium is rare or dense? Most of the estimates that have been made lead to the conclusion that it is very rare. They each depend upon some unproved assumption. We have no conclusive *proof* as to the density of the medium. It is generally thought that, because we do not directly perceive the medium, it must be very rare. This is by no means the case. To return to the being immersed in the ocean of liquid, he was unable to perceive. Whether it were a dense liquid or no, would not make any difference to him. If it were dense, he would, no doubt, in moving his limbs, feel that he had to exert himself a good deal in order to start them moving on account of all the surrounding liquid he would have to set moving. If he was suddenly transferred to a very rare medium, he would perceive the difference. Like the ancient mariner, he "felt so light, almost," "he thought that he had died in sleep," "and was a blessed ghost." But then this was supposed not to be one of the experiences of this being. He was always accustomed to have to move all this dense medium whenever he moved his limbs. In fact, he had never attributed this inertia to the medium at all. He had always attributed it to his limbs. In a similar way we, when we move a stone or a bit of lead or platinum, attribute its inertia to the body

moved, while really the inertia may be due to the medium we move along with the body. This must actually be the case if the hypothesis already mentioned, as to the nature of matter, be true. If matter be itself only a part of the medium, which is possessed of some peculiarity of motion, then the inertia of matter is merely the inertia of the medium itself. If this be so, it would appear as if the medium must be *at least* as dense as platinum. When we move a piece of platinum, we may not move *all* the medium inside it, and in that case the density of the medium may be much greater than that of platinum. There is nothing certainly known to disprove such a hypothesis. If, for instance, the medium be five times as dense as platinum, *i.e.*, about one hundred times as dense as water, all that it would require would be that when we move water about we are only moving the one-hundredth part of the medium that occupies the space of the water, and this does not seem at all an impossible hypothesis. If this be so, how much energy may there be in one cubic foot of ether? There will be about one hundred million of million of million foot pounds of energy. This would supply a million horse-power for five thousand years. Such a calculation as this does not pretend to prove that there *is* this energy in each cubic foot of the ether. All it pretends to is to show that in our present desperate condition of ignorance, we know nothing with absolute certainty that *disproves* the possibility of this energy being there.

Is this energy available? Well, it is not safe to prophesy what is and what is not possible. Most prophesies as to what is and what is not possible have proved untrue. Until, however, we have discovered how to utilize the immense known stores of energy in each cubic foot of gross matter, in the earth, in the water of the sea, and in the air about us, energy whose nature is pretty well known and whose amount we can approximately estimate, until we have found out some way of doing this, it seems very unlikely that we shall be able to utilize the energy of the ether, even if we are right in our hypothesis that it exists.

Each cubic yard of air possesses more than four foot tons of energy, owing to the motion of its molecules, and yet we have not found out any way of using this. If we could only catch hold of whichever of the molecules we wished and harness them to a car, and let these go when we had got all the energy out of them we required and harness up fresh molecules, it would enable us to use this energy. The discovery of how to use the chemical energy of coal would be absolutely nothing compared with this. It has been suggested that some of the minuter bacteria are able to do this. Is it impossible that larger organisms may be able to do it? Is it impossible that they may develop the ability thus to sort out the molecule they require in their own superficial cells? If bacteria have developed this ability in their cells, may not mankind by judicious selection or by other means attain a similar ability? We could easily fly then; we could do many other wonderful things. We may fly before that. A surface set suddenly in motion with a velocity greater than that of sound in air would, at least temporarily, have a pressure of nearly fifteen pounds per square inch on its surface, and an area of twelve square inches would then support a heavy man. This is, however, quite beside the matter in hand.

And what *is* all this fierce motion in space which we desire to direct in accordance with our wishes? How do we now direct motion in accordance with our wishes? Is there any motion directed in accordance with our wishes? Certainly there is, if "in accordance with our wishes" has any real meaning. We can often direct the motions of our limbs in accordance with our wishes. By experience gained in childhood, by carefully conducted education, by following the experience of others, we direct many, very many, motions outside our bodies in accordance with our wishes. We do this by learning what we call the law of nature, or the rules of that great organism with which we have to work, and accommodating ourselves to them. But what is the "we" and what are "our wishes?" What is the "I" of another person? In old times people used to attribute

feelings and sensations and thoughts to the heart, liver, spleen, etc. Nowadays we locate all these in the brain. Why? Because we find that an animal can get along very comfortably without a liver or spleen for a short time, so long as its nervous system, of which the brain is such an important center, is kept in working order. So long as the brain is in working order a person can feel and think. If it is out of order or improperly supplied with blood the feeling and thinking are disordered. There is every reason to suppose that our feeling of light is concerned with one series of brain cells, our feeling of sound with another; that so long as we feel light there are certain changes, *i. e.*, movements going on in one set of brain cells; while we are conscious of beauty some kind of change is going on, maybe not only in our brain cells but a concomitant change affecting our whole system. Somebody has recently shown reason to suppose that angry passions produce a poison which disorders the digestive system. It is quite likely, after all, that the spleen may be concerned in these things, and the liver too. Anyway, what is of importance at present is that the only way in which another person's angry passions exist as a reality for *me* are as very complicated movements in their organism. We do not know what movements in the brain cells correspond to the sensation of red light, nor what to a shrill sound. Neither movement is probably one bit *like* the vibrations of the eye molecules, nor of the ear molecules, that excite the cell motions. A waving flag may signal to a general information as to an enemy's manœuvres which leads him to rearrange his infantry, cavalry, and artillery. But these movements of his army are not a bit like the waving flag which started them. We can, however, trace a connection between them. They are things of the same kind. They are both movements of matter. Similarly, the movements of the ear-drum and those of the brain molecules are things of the same kind. Every action I can perceive in another person is of this same kind. But the shrill sound I perceive is not of this same kind. Ugliness and guiltiness are not movements of matter. But then I can-

not perceive the shrill sound that another person feels. We may both, no doubt, in a colloquial sense, hear the same sound, but I am not conscious of the other person's feeling. The same source causes two feelings, one in me, the other in the other person. I feel my own feeling, I cannot feel the other person's feeling. The only way in which the other person's feeling exists for me is as a movement in his brain, the only way in which my feeling exists for him is as a movement in my brain. We know as yet no way of getting behind this. There seems every reason to think that what is behind this movement may be as complicated as the army manœuvres compared with the waving of a flag. It is hard to see how otherwise to explain the fact that brain movements can correspond to such a variety of feelings as light and sound, beauty and ugliness, goodness and guilt. It is well to call all these "feelings," notwithstanding the boy who defined an abstract term to be a thing like conscience that one cannot feel. It is always necessary to recollect that to *me* these feelings are the only reality; other people's feelings are to me an elaborate and frequently erroneous inference.

One of the most interesting investigations of the present day is as to the positions of atoms in molecules. The whole system is too small to see. We can form some rough conception of their arrangement from their behavior, just as we can form an estimate as to the orbit of a double star from the changes in its spectrum, even though the components are far too close to be separately visible. We are gradually learning how to read, in the spectrum, the story of what is taking place in molecules, too. There is some prospect that we may some time even be able to tell what movements in the brain cells correspond to a sensation of red light, and, if the world lasts long enough, and mankind is good enough, we may be able to discover what movements in his system corresponded to Wilberforce's determination to put down slavery.

But if the spleen is involved in angry passions, it is evident that motions outside our brain and even our nervous

system are involved in feelings and thoughts. Where does our brain end? Where does movement cease to have a corresponding thought? Surely all movement must have a corresponding thought. And perchance when we know the movements corresponding to a determination to abolish slavery we may be able to form some dim conception of the thoughts that correspond to the movements of the earth, of the solar system, to the development of species of animals and plants. These thoughts will not be our thoughts, nor our ways their ways. That they are not does not necessarily place them beyond investigation. We already know much about four dimensional space, and can state things true of multi-dimensional space, though even of four dimensional space we can form no concrete conception. In the same way we may hope some time to make scientific statements about the thoughts of the universe, though we may be quite unable to reproduce them as our thoughts. Even now we deal with the universe as with a person. How do we get others to do what we wish? By making them feel our wishes directly? No. By paying attention to the laws of their nature and by so acting ourselves as to cause them to act as we wish. Is not that also a description of how we act on nature? How do others act on us? By speaking to us with signs. Does not nature speak to us in the same way? We interpret other people's signs and judge that they have corresponding thoughts. Are we then wrong in considering the signs of nature as the language in which the thoughts of nature are expressed?

All the greatest, wisest, best have implored and exhorted mankind to believe this. Prophets and seers, philosophers and poets, have taught mankind this faith. We have faith in the existence of the thoughts corresponding to other people's brain-movements. Without this faith life would be a mockery. Is it not almost a mockery without the greater faith? The greatest, wisest, best have said so. It is the almost necessary conclusion of science. Science has by itself no *proof* of the existence of other people's thoughts. Science then cannot be expected to prove the existence of these

thoughts more complex, indeed, than other people's thoughts, but which can, for all that, be safely called thoughts. Do we not show our wisdom by holding fast by the teaching of the greatest, the wisest and the best? Is it not the most glorious prospect for science that it may one day give a definite form to the greatest thoughts of mankind's greatest sons?

CHANGES IN SPOKEN ENGLISH.

By A. B. Kingsbury.

The President's English differs but slightly in outward form from the English of Cromwell and the Commonwealth, though more than two centuries have elapsed to change it. Apart from a few peculiarities of orthography and syntax which have now grown obsolete, Dryden and Pope, and the writers of half a century before them, are no more difficult to read than Tennyson, so firmly has the printing press stereotyped their written usage of word and phrase. Unfortunately, there has been no phonograph to preserve for us the spoken English of their time, and to exhibit its exact points of contrast with our present speech; but an examination of the grammars and word-books of that era, together with the study of the rhymed lines of the poets, furnishes abundant evidence of changes in pronunciation so numerous and so radical that to the ear of an American of to-day the spoken language of the Puritans would be an unfamiliar tongue.

If Governor Winthrop, for example, could arrive in Boston again in his good ship Arabella, as he did two and a half centuries ago, and could stroll up Beacon street, his speech would seem not less strange than his doublet and ruff, while in the matter of conversation, at least, he would find himself more at ease in the company of a raw immigrant from the north of Ireland than in the society of a club man. If this

immigrant were an intelligent young woman he might, indeed, fancy that he heard from her lips the speech of one of his old servants; for it is by women rather than by men that purity of pronunciation is maintained through their greater distinctness of articulation, and it is the young country woman from Ireland who speaks the nearest approach we have now to the language of the Pilgrim Fathers. To paraphrase the Italian proverb, it is the Ulster dialect in the Galway girl's mouth that, historically speaking, is our purest English. In the isolation of country life, away from books and newspapers and intercourse with cities, the schoolmaster's refinements of orthoepy are slow to creep in, and the old forms and standards linger. It is the liberal life of the city that brings innovations. Voltaire returned to earth would find the language of the little French villages of Canada more familiar to his ear than the French of Paris; and Winthrop, if he strayed into the mountains of West Virginia, Carolina and Tennessee, would hear homely words and idioms that were lawful coin in his own time, but are now worn too smooth for easy currency. They survive and live on there in lonely cabins and in remote villages along with the old manners and customs and blood of Captain John Smith's colonists. They survive, too, in the back districts of New England. These survivals are not difficult to understand when it is remembered that while Jamestown and Plymouth were settled in 1607 and 1620 respectively, James I. established his colony in Ulster, in the north of Ireland, in 1611, and Cromwell made his settlement in that region about forty years later. In this manner the English language of the early part of the seventeenth century was colonized, so to speak, in three remote regions, at practically the same time, and nearly two centuries of isolation served to crystallize its pronunciation.

The most notable and important of these phonetic changes are those that have taken place in the vowel sounds. Thus, the diphthong *ea* with the value of long *e* as in *cheat*, *beat*, *treat*, *feat*, was a polite affectation in Dryden's day in the speech of London. Not until after his death did it get firm footing

in popular English, and even long after Pope's time the words were pronounced as if spelled "chate," "bate," "trate," "fate," just as an Irishman would pronounce them to-day. Of this there is abundant proof to be had from the seventeenth century poets. Both Milton and Dryden rhyme *tears* (the noun) with *wears*. Pope rhymes *speak* with *take*, *mead* with *shade*, *tea* with *obey*, as

> Here thou, great Anna! whom three realms obey,
> Dost sometimes counsel take and sometimes tea.

And Swift has:

> * * * Let me now survey
> Our madame o'er her evening tea.

This pronunciation of *tea* lasted in good use in England until 1750. Dryden rhymes *sea* with *they*, *treat* with *state*, *weak* with *break*, while other poets rhyme *steal* with *sail*, *peace* with *place*, *sea* with *survey* and *obey;* so Cowper, much later, in his:

> I am monarch of all I survey;
> My right there is none to dispute;
> From the center all round to the sea
> I am lord of the fowl and the brute.

This pronunciation of *ea* gives point to Shakespeare's familiar pun on "reasons" (raisins) and "blackberries;" *bear tear*, *great*, *yea*, *O'Shea*, *McLean*, exhibit the old sound of the diphthong. Similarly the diphthong *ei* was often, in the seventeenth century, pronounced as in *eight* and rarely as in *conceit*. Pope rhymes *receives* with *waves*, and like rhymes are met everywhere. In some parts of Connecticut, even as late as sixty years ago, deceit was pronounced "desate," *conceit* "consate," *receipt* "resate," and in Central New York, at the present time, the phrase, "I consated (*conceited*) it" is not infrequently heard on the lips of the old. How our New England forefathers pronounced this diphthong is shown by the phonetic spelling of a military order preserved in the Revolutionary Records of Massachusetts, in which, under date of October 26th, 1775, directions are given for the delivery of some bounty coats to Lieutenant John Patrick, "whose Recait shall be your safety."

Long *e* in Pope's and Dryden's verse is frequently the *a* of *fate*. Not until the eighteenth century had it gained the full value of *e* in *mete*, and its degradation from the position it had in the earliest English, and maintained for a thousand years, to the sound of the Italian *i* is one of the most remarkable phonetic changes in the language. The Kilkenny dialect which makes *fever* "faver," and *decent* "daycent" preserves the old sound. The short *e* sometimes had the value of short *i* in the seventeenth century. Dryden rhymes *devil* with *civil*, and *sense* with *prince*, and the Irish "chist" for *chest*, "intered" for *entered*, "intirely" for *entirely*, keep alive this old usage. The Irish pronunciation of *Dennis* as "Dinnis" is the correct one, historically considered. *E* followed by *r* has the significance of *a* in *dark*, survivals of which are seen in the modern English pronunciation of *clerk* as "clark," and *derby* as "darby." In New England half a century ago *mercy* as "marcy," *clerk* as "clark," *sergent* as "sarjeant" were in common use, and some old-fashioned people cling to them still. This usage survives largely among the Irish, and is embalmed in the personal names Clark, Marcy, Darby and Sargent. In some districts of Tennessee a *perch* is still a "parch."

Long *o* of *note* had not become firmly fixed in Shakespeare's time in many words in which it is now well established. Two instances of this are shown in the poet's punning rhymes of *choler* with *collar*, and *dolor* with *dollar*. The *o* of *shore* appeared in some words from which it has since departed. *Groton*, in Massachusetts, is pronounced "Grawton" by many old people who do not stop to think that this was the pronunciation in the English town from which some of their Pilgrim forefathers came. *Glorious* was "glawrious" in those days, as it is still in some Episcopal churches. *Ow* was often *oo*, Cowper and Cowley being "Cooper" and "Cooley" in England to this day. The settlement of the Cowley Fathers in Boston has revived this old pronunciation there.

I was sometimes *ee*, Shakespeare rhyming *ship* with *sheep*, and Dryden rhyming *mill* with *keel*, while Pope rhymes *mill*

with *feel*. *Ie* had the sound of the short *e* of pert in *pierce*, *tierce*, and *fierce*, which were pronounced "perse," "terse," "ferse." The name of Franklin Pierce, the President, was universally called "Perse" in New England. Milton in "L'Allegro" has

> Married to immortal verse
> Such as the meeting soul may pierce.

As late as 1820 Byron, in the sixth canto of "Don Juan," has *reverse* rhyming with *fierce* and *pierce*.

The diphthong *oi* was like long *i*, having the value that it still possesses in *choir*. Pope rhymes *noise* with *cries*, *join* with *nine*, *joined* with *mankind*, and Dryden has *defile* rhyming with *despoil*, *purloin* with *thine*, and *reclined* with *joined*. They called a boy a "bye" then, as the Irish do to-day. In the back districts of New England, even now, *oil*, *spoil*, *boil*, may be heard as "ile," "spile," "bile."

Among these phonetic survivals none has been more persistent than that of *were* as "ware" and *year* as "yare," and few more interesting. In the same category may be put *are* as "air," though this has become distinctly "vulgar," while the others are still in the South in reputable standing. Pope's rhyme of *were* with *care*, and Dryden's rhyme of *bears* with *years* are still legitimate in verse, as they are common in every-day rural speech, in some of the Southern States. The following couplet, taken at random from the recent verse of a Georgia poet, is one case in point of many that might be cited of the prevalence of this pronunciation:

> Suppose they were to send you as a missionary where
> The Eskimo makes fire out of whale oil half the year!

R has fallen in grace since the time when it was rolled as the Irishman continues to roll it. The frequent use of "alarum" for alarm shows its value in Pope's day. How sadly this letter has deteriorated from its old value is indicated by the difference between an Irishman's pronunciation of the word work as "wurruk," and a Kentuckian's pronunciation of the word *sir*, formally *sirrah*, as "suh;" or a New Yorker's pronunciation of the name of the metropolis

from which he entirely eliminates the *r*. In Boston the ear can distinguish no difference between the pronunciation of *gutter* and of *gutta*, as in *gutta*-percha, and yet the children of Boston people, who settled in the west forty years ago, pronounce it distinctly. Dryden's rhyme of *affords* with *words*, and Pope's rhyme of *works* with *corks* are impossible to-day, but they furnish excellent evidence of the letter's loss of strength.

Short *u* in the seventeenth century had in *put* the same value that it had in *shut*. In southern Ohio *put* keeps its old pronunciation. The long *u* of *pure* was just beginning to gain vogue in Elizabeth's time. Two hundred years later it was exceedingly popular in words like *rule*, *rude*, *dupe*, in which it is now giving place to the *oo* of *school*. Nowadays it is fast losing its value of *yoo* and deteriorating into *oo*, all because of slovenliness of diction and that vocal laziness, so to call it, which is the primal moving cause of phonetic change—the indisposition to any unnecessary exertion of the vocal cords. As it is easier to say "doop" than *dupe*, most people (and it is the people and not the saving remnant of the Purists who make the laws of language) say "doop" just as the sailor finding *Bellerophon* an inconvenient mouthful, calls it "Belly Ruffin." Another cause of this tendency, where it shows itself among persons of usually correct speech, is the influence of school-room instruction in Latin, German, Spanish and Italian, where the *u* has almost always the sound of *oo*. The change is so general that the dictionaries cease to mark the sound as obligatory in many words in which it was essential a few generations ago. So conservative an authority as the late Prof. William Dwight Whitney says:

"There has long existed a tendency to lessen or remove the *y* element in certain situations unfavorable to its production. After an *r* the pronunciation *oo* has taken the place of *u* so generally as to be alone accepted by all recent authorities, although some speakers still show plain traces of the older utterance. The same has happened in less degree after *l* and some of the latest authorities, even in England, prescribe always *loo*. But further, after the dental consonants

t, *d*, *n*, *s*, *z*, the usage of the majority of good speakers tends to reduce the *y* element to a lighter and less noticeable form, *while many omit it altogether*, pronouncing *oo*."

This would give us the derided "nooz" and "noozpaper," as well as "dook," and doubtless we shall have them in good standing soon despite the protests of the Purists. These critical brethren have long made a shibboleth of "dyuke" —ever since Thackeray held up to ridicule the cockney who called the hero of Waterloo "the Dook," and perhaps before. Apparently they are fighting now in their last ditch.

A final word about the dialect of the West Virginia mountaineers, which is extremely rich in fossilized forms of the orthoepy of three centuries ago. In "pinted," "jined," "suddin," "cotch," "leetle," "git," "repint" (for *repent*), "ragler" (for *regular*), "sarpint," "varmint," "chice" (for *choice*), "sarch," "pictur," "sartin," "air" (for *are*), and a hundred other colloquial words they have retained the old pronunciation. They use *fetch* in its old sense of *bring* and *carry* almost universally, and in *afeared* they keep in good use a word once as legitimate as *afraid*.

> Be not afeared; the isle is full of noises,

says Shakespeare, in the Tempest. They use "chuck" (*to throw*) as freely as in the days before it had fallen from grace, and their "chimley" for *chimney* is the old dialectical variation. Their "cheer," "keer," "skeer" and "sheer" for *chair*, *care*, *scare*, *share*, show how the long *a* of *fate* weakened into the Italian *i*. Both the Irish and the mountaineers omit the final *g* from the participial ending *ing*, as good speakers are supposed to have done in Pope's day. When Dean Hole was criticised during his recent lecture tour of the United States for this fault, he said, in admitting it, that this was the general practice of cultivated speakers in England.

ELECTRIC POWER TRANSMISSION.

By Lieut. F. Jarvis Patten.

No industrial advance has made such rapid strides in this century as that of power transmission by electricity, which has now had less than a single decade of growth. We are scarcely aware that such power transfer is an accomplished commercial fact; yet thousands of horse-power are being daily sent over the slender copper thread that connects one place to another, and by so doing practically eliminates the space that separates them.

If there is one thing, therefore, in the material progress of the latter part of this century for which its workers may feel an excusable pride, it is not so much the railroad and the modern steamship, the latter a comparatively recent creation, but the possibility which now stands a demonstrated fact, of sending over an inert and motionless wire the energy that nature has placed here, to a distant point where it is needed, and where it can neither be found nor economically made.

Of all engines, the dynamo, or generator of electric current, is doubtless the simplest in construction, operation and control. Some moving wire in proper relation to a magnet is practically all there is to it. Yet this machine, discovered by Faraday in the early part of the century, was the object of but little scientific attention or study until the last quarter of the century. Professor Pacinotti, of Turin, early in the sixties made a marked improvement in the Faraday machine by so constructing it that it would yield a uniform direct current like that derived from a battery, by which device all electric apparatus up to that date had been operated. This advance, one would think, should have given an immediate stimulus to electric discovery and progress. Not so, however; it was not till some years later that Gramme, a Belgian engineer, having seen the Pacinotti

machine, and appreciating the marked advance for certain uses that this new construction promised, set about building larger machines on the Pacinotti plan, and, so doing, made the first practical arc-light machines.

This beautiful result, the arc-light, the first practical outcome of the modern dynamo, must needs be given the highest possible degree of perfection, and this result was in fact the stimulus that gave a new and lasting incentive to the development of the modern electric generator. The evident demand for the new illuminant produced the new machine, the direct current series arc-lighter—in no essential feature very different to-day from those first made by the Belgian engineer.

It should be remembered that at the time this machine had reached a fair degree of perfection, the incandescent or glow lamp, accredited to Edison, had not yet been perfected, and the new type of dynamo which it required, and which now as a motor does the electric street-car work of the world, was not then known; so it came that the first attempts at power transmission were made with the early arc-light machines, and this by a simple accident which it is hardly any exaggeration to say actually delayed electric power transmission by a whole decade. This accident forms an interesting bit of electrical history, which makes it worth recording, and shows, by the way, how scientific advance—which of all things should be ever the result of predetermined calculation—sometimes goes on the hit or miss plan. At the Vienna Exposition, in 1870, a number of the Gramme machines were used in connection with an arc-light exhibit. The Exposition was about to be formally opened, but, as generally happens on such occasions, matters were far from completely arranged in many exhibits. Among these happened to be the Gramme arc-light display, where a machine had no connection to any circuit, and numerous cables lay about in disorder. To improve the appearance of things somewhat, a workman took the two loose ends of a circuit from a machine that was running and connected them to the idle machine. To his great astonishment the

machine thus connected to the driven arc-lighter started revolving without any apparent power to drive it.

This was the first instance the world had seen of one dynamo operated by steam-power as a generator of current, working a similar machine as a motor by the current sent to it from the first. Of course, the distance was not great, being only a few yards, yet all the essential features of the transmission of power by the electric current were there in operation.

The fact was reported to the authorities, who, of course, knew that the second machine should be driven by the current of the first, inasmuch as the two machines are necessarily reversible in their operations, but, singularly enough, none of them had ever thought to try it, and so by fortuitous accident, the exhibit was greatly enhanced in value by the addition of an operation hitherto unknown, and the industrial world was given a new and fruitful idea.

Here was at least material for the engineers that contained great possibilities. How far could this principle be made operative, and what, under different conditions of distance, would be the percentages of loss?

These were highly interesting questions for the industrial world, as well as for the engineers and scientists, and all were soon at work on their respective features of the problem. The French, as usual, were the first to seize the problem seriously, and within a few years of the Vienna demonstration, the celebrated Munich experiment had been completed under the direction of Marcel Deprez, engineer for a Paris syndicate, deserving the highest praise for their enterprise and early devotion to this problem. The Munich experiment, the first attempt at power transmission to any considerable distance, was very simple, and involved little more than the putting into operation on a larger scale what had taken place in the exposition hall at Vienna. Two arc dynamos were connected by a two wire line in series relation, the distance separating them being about fifteen miles, and elaborate tests were made as to the line losses and the motor losses of this system of

transmitting power from one place to another. Great disappointment was felt at the best that could be got from this apparently elaborate and crucial test. The figures showed a loss of something more than fifty per cent. of the power delivered to the line. The experiment was thus marked a commercial failure, and electric power transmission had its first serious set-back. The French went on with more extensive and more costly experiments, without, however, in the course of a few years making any essential progress.

As usual in such cases the engineers could tell what the trouble was, but were forced to the confession that the remedy was not so easy to suggest. The fact is, these experiments were made with a type of machine ill adapted to power transmission, using, as they did, a comparatively low voltage arc-light dynamo as generator and motor. It was evident that a greatly increased voltage on the line would materially decrease the losses, but high voltages had not been handled, and the commutators necessary in machines of this type introduced serious difficulties and no little danger in using a very high voltage in such a system, which should be made sufficiently simple to admit of being handled by the workmen necessary about such plants.

Alternating current dynamos, machines of the old Faraday type not then developed to any great degree of perfection, offered peculiar advantages for this work, because, in the first place, they required no commutators, and dangerous or injurious sparking would be avoided by inherent qualities in the machine. Further, a very high line-voltage could be used without using a dangerously high voltage in either the dynamo or the motor, this because of the ease with which the alternating current can be altered or transformed in voltage by an apparatus so simple that it has no moving part. This was all known in a general or theoretical way at the time of the Deprez experiments, but the transforming apparatus and its handling had not received any development. To these objections to the use of the alternating current was added another difficulty, that appeared at the

time quite insurmountable; the alternating dynamo, it was found, would not start and run as a motor as would the direct current arc-machine of Gramme. It was owing to simple, but apparently insurmountable difficulties like these, that power transmission by electricity was delayed for years. The inventions with which the early experiments were made were not adequate to the work, and years were to pass before inventions made for other purposes should remove the obstacles that stood in the way of the Deprez experiments. Just as the early evidences of the possibility of power transmission were the outcome and the result of early apparatus built for arc-lighting, so the later and more perfect power system grew to a large extent out of the later incandescent or glow lamp machinery.

Close upon the heels of the arc-light came the Edison incandescent lamp, necessitating the use of constant potential dynamos, and, strange to say, the alternating machine of the old Faraday type, which might as well have been perfected in the thirties, rapidly asserted its superiority for incandescent lighting, and is now almost exclusively used where current has to be sent to any distance.

So it happened through the growth of incandescent lighting that alternating current systems were brought to perfection. The transformer, by which voltage is raised or lowered at will by a safe and simple apparatus, was soon perfected, and the use of from two thousand to five thousand volts on the line became an every-day affair. The one great obstacle to the use of this sort of machinery for power transmission was not, however, finally removed until 1888, by the Tesla invention of the rotary field motor. The ordinary alternating dynamo will not start as a motor, as will the direct current machine. By the use of an alternator giving a double current, however, Tesla showed that the second machine or motor became a self starter. Thus the last obstacle to the use of alternating current machinery for power transmission was removed, and from that time to the present the advance of this industry has been almost a triumphal march. Although this last invention was an American one, the Ger-

mans were the first to appreciate its high value and to give it practical demonstration and proof.

The celebrated Lauffen-Frankfort experiment marked the development of a new era. At about the time of the Frankfort Exposition in 1891, one of the wealthiest manufacturing concerns in Germany had just completed a plant for sending a few hundred horse-power by the new alternating system of Tesla from the falls at Lauffen, on the Neckar, to a manufacturing town not many miles distant. They conceived and, with some assistance, put into operation the bold idea of sending one hundred horse-power to the Frankfort Exhibition, one hundred and twelve miles distant. This feat was accomplished with great success. They used from ten thousand to thirty thousand volts on the line, and three copper wires smaller than an ordinary lead pencil sufficed to carry the power to Frankfort, with a loss of less than twenty-four per cent. in line and motor at the distant end. The motor was of the alternating triple current type, the form now most in favor among German engineers. With the perfection of alternate current apparatus electric power transmission has thus found a complete and satisfactory solution. Since the Frankfort demonstration many large plants in Europe have been installed with the expected successful results, and quite a number in the United States, where, at Niagara Falls, we are just witnessing the completion of the greatest electrical enterprise that the world is likely to see for a century to come. This installation has taken about four years to reach completion, but now bids fair to justify the labor and capital spent upon it. Something like a mile above the falls a closed canal, or basin, is dug on the American side. From this basin, the water of which is at the level of the upper river, canals run into the power house, where they terminate in shafts some one hundred and twelve feet in vertical depth, and which debouch into a large tunnel, or sluice-way, which carries the waste water down to the river below the falls, nearly a mile away. The construction of this tunnel and the several wheel pits, of which there are ten now finished, each having its shaft to the pond

above, have been the principal items of cost. Ten dynamos of five thousand horse-power each will be the first plant, but ample arrangements are made for increasing this output. At the bottom of each shaft is a turbine wheel, surprisingly small in size for the power it gives, but under the enormous head of one hundred and twelve feet the forty-inch wheel will yield five thousand horse-power. The wheel spindle, a hollow steel shaft, nicely balanced, carries on its other end, in the power house at the top, the revolving part of a five thousand horse-power alternating dynamo of the double current type.

Much of the power will be used at Niagara in the mills of the immediate vicinity. A large part of the entire amount generated by the ten machines first installed will be sent to Buffalo, twenty-eight miles distant, and to the neighboring (proposed) manufacturing town of Depew which it is intended shall derive its lights and power from the cataract at Niagara. The dynamos at Niagara will generate seven thousand amperes at a pressure of two thousand two hundred and fifty volts, not a very high pressure for modern alternators, but the distance is not great. The line wires will be underground, and near Buffalo the voltage will be reduced by transformers to two hundred—an ordinary voltage for city lines.

The Niagara Company have already under control facilities for operating the Canadian side of the falls, and a somewhat wild imagination may be trusted to predict what another half century will see as a result of this beginning. With the possibility of sending power in this way one hundred and fifty miles economically, there is every reason to expect in the near future an industrial manufacturing centre within this radius of Niagara Falls, sufficient to do a large part, if not all, the manufacturing of the United States.

HANDS;

AS INDICATIVE OF CHARACTER, PAST AND FUTURE EVENTS, AND OF ALL THAT RELATES TO THE INDIVIDUAL.

By Cheiro.

> —And would we question Fate? Methinks
> In life's long chain we are the little links
> That stretch the endless whole; and thus I teach
> As part of life—so are we part of each. Cheiro.

In examining a study of this kind from a practical and logical standpoint, it is well to remember that all recent discoveries in regard to the influence of the mind over the body go far to prove that the old-world art of Cheiromancy rested on a foundation natural, logical, and scientific.

If one will consider for a moment the claims that such a study has for consideration, not only on account of its extreme antiquity, but in regard to the position which it occupied among nations famous for their learning and depth of thought, one will be inclined to admit that it must have had some more sure foothold than the fanciful theories of the ignorant and superstitious. Tracing it back from country to country, we find that it has a literature of its own in the Aryan civilization, the oldest in the history of the known world, and associated with a people whose philosophy even the Greek schools of learning have been found to follow. Again, looking to a closer period in the onward march and development of mankind, we reach the Grecian civilization and find the study of the hand not alone in favor, but being taught and practiced by men whose names are to this day as stars of light in the firmament of knowledge. Now, whether these people were more advanced and enlightened than we are, has long been a question of dispute. The point, however, which has been admitted, and the one which concerns this subject most is, that as in those days the greatest study of mankind was man, it therefore follows that in a study like this, their conclusions are far more

likely to be right than are those of an age like the present, one famous for its implements of destruction, its steam engines and its commerce. Again, if by teaching in our colleges and schools the wisdom of the Greeks, we admit that those philosophers were men of extraordinary depth of learning, and that their works, thoughts and ideas are worthy of the deepest respect, why then should we consider lightly their authority in this matter, and throw aside a study that so deeply occupied their attention?

As in the study of mankind there came to be noted a natural position on the face for the nose, eyes, ears, etc., so also on the hand there came to be recognized a natural position for the line of head, the line of life, and so forth. The time and study devoted to the subject enabled these students to give names to each mark, as the line of head, denoting mentality; the line of heart, the affectionate temperament; the line of life, longevity; and so on with every other mark that the hand possesses.

Among the Greeks this study numbered among its followers such men of learning as Anaxagoras, Pliny, Aristotle, Cardamis and others. Hispanus, in sending a work on cheiromancy to Alexander the Great, described it as "a study worthy the attention of an elevated and inquiring mind."

It was the Church alone which, it is said—jealous of the power of this old-world science—ranked it with sorcery, witchcraft, "and all such abominations of the devil," and, by the fierceness of its persecution, forced it into the hands of outlaws, gypsies and vagrants. Such an action on the part of the Church is not surprising, when even in our own day it constitutes itself in all matters, both spiritual and temporal, the chosen oracle of God. Without being either antagonistic or intolerant, one cannot help but remark that the history of any dominant religion is the history of opposition to knowledge, unless that knowledge proceeds from its teachings.

This strange study, the child of pagans and heathens, was therefore not even given a trial. The strictest laws

were made against it, and as early as 315 A.D. we find the ecclesiastical court making a decree which has been the basis of all the Continental edicts on the subject, and which is almost word for word with a similar law made in England during the reign of Henry VIII., and also with the Act of George IV., in which it states that "any person practicing palmistry is hereby deemed a rogue and a vagabond, to be sentenced to a year's imprisonment, and to stand in the pillory."

In view of the opposition of the Church, it is interesting to notice the many important phrases in the Bible in which there is a significant mention of the hand. The verse, however, which has been most largely quoted as bearing on the subject, is the seventh of the thirty-seventh chapter of Job. In the original Hebrew, it appears to have a very different meaning from that given to it by the English version. One translation of it runs, "God placed signs or seals in the hands of men, that all men may know their works." This verse, in about the middle of the sixteenth century, caused one of the most interesting discussions among theologians and commentators. Many of them advocated the cheiromantic aspect that the lines of the hand are "the markings of God, that all men may know their works." Among the many learned men who openly supported this view were Franciscus Valesius, Schultens, Lyrannus, Thomassin, and Debrio, but the translation of the Bible into English at a time when the opposition to palmistry, sorcery, and witchcraft was at its height, is presumed to be the cause of the wording of the verse as it now stands.

Let us now see what modern science has done for the acceptance of such a study, and if there be any foundation for its claims beyond those of mere hypothesis and speculation.

In the first place the concensus of scientific research has placed the hand as the immediate servant of the brain, under the direct influence of the mind, and the still more mysterious influence and subtlety of thought. Sir Charles Bell, the greatest authority of the present age on the nerve

connection between the brain and the hand, commenced his famous Bridgewater treatise in 1833 by writing:

"We ought to define the hand as belonging exclusively to man, *corresponding, in its sensibility and motion, to the endowment of his mind.*" The same scientist, later in his work, demonstrates that as there are more nerves from the brain to the hand than in any other portion of the system; and that, as the action of the mind affects the entire body, it therefore follows that every thought of the brain more immediately affects the hand, and consequently its formation.

The most prejudiced skeptic will readily admit the enormous difference that exists between the hands of persons of different temperaments. Nature does nothing without a purpose; there must therefore be a meaning to such differences, as is the case with differences in animals. To the judge of horses, the slightest variation in the contour of the limb contains, to his practiced observation, a language in a line. Why not, then, in the observation of the hand? It stands to reason that if we can so easily prove that variation of shape contains a meaning, so must every other variation in connection with it, whether it be of nerves, skin, lines, or nails. Looking at the study, then, from this standpoint alone, it holds good that there is a meaning in difference of formation, and, if a little through casual observation, why not a great deal if a sufficient amount of study be devoted to the subject?

We will now turn our attention to the lines, and examine the arguments, both for and against.

The chief argument against the study is generally brought by people who, from ignorance or want of examination of facts, rashly jump to the conclusion that the lines of the palm must be made by folding and constant use. The direct opposite is, however, the case, as in medical work it is a well-known fact that in certain cases of paralysis, long before the attack takes place, the lines completely disappear, although the hand continues to fold as before.

Again, if the lines were made by use, the woman working with her hands for daily bread would, according to all the

laws of logic, with such constant folding, have some thousands of lines and cross lines in her hands by the time she reached forty, while the woman of luxury would have scarcely any. But once more the direct opposite is the case, as will be proved by the most casual observation.

If, therefore, the lines are not made by the action of the hands, who will prove that they are not caused by the action of the mind?

Meissner, in 1853, proved the existence in the hand of the tactile corpuscles, "running in straight rows in the red lines of the palm." He afterward demonstrated that these corpuscles contained the ends of the important nerve fibres, and that during the life of the body they gave forth vibrations and crepitations, distinct and different in every person, which changed under the influence of every change in the system, and which ceased the moment life became extinct.

It is impossible, in the space at my disposal, to enter into the wealth of scientific evidence which goes far to prove the general belief in a nervous fluid, essence or principle that conveys every change of the active or passive brain directly to the hand. But enough has been written to prove that, as the hands are the servants of the system, so all things that affect the system affect them.

And now the future: one will readily ask the question, How is it possible to believe that coming deeds and actions can be marked in advance?

In answer to this, I draw attention to the fact that it has been demonstrated by scientists that every portion of the brain may grow, diminish or change, and correspond in such changes to those of habit, temperament or talent developed by the individual in the every-day actions of life. As the brain evolves from childhood to manhood, it follows that there must be an *advance growth* before it can reach the point of power or action. The slightest change, it will thus be seen, *must affect the body in advance of the action.* Is it, then, illogical to assume that the hand, to the student of such things, denotes the change going on in the brain, even years

before the actions of the individual become the result of such a change?

The most casual observer cannot fail to notice the enormous difference that can be seen between the shapes and positions of the line of head alone, on the hand of the congenital idiot, as compared with that of the man who has a clear brain and a superior mentality. Therefore, if proved in one instance that certain marks on the line of head denote this or that peculiarity mentally, the same course of observation, it is not illogical to assume, will, if persisted in, be also accurate in its findings as regards health, illness and death, and also in regard to prosperity or the reverse.

In the investigation of such a subject, it must not be forgotten that in various parts of the world this study has been cultivated for centuries in succession, and the most careful annals and records kept in regard to almost every mark that can be found on the hand. During my stay in India I was permitted to examine and use a large book on such markings, which was jealously guarded in one of the Brahmin temples, as a thing almost sacred. This strange volume was made of human skin, wonderfully pieced and put together, and written in a red liquid that age had failed to destroy or fade. It contained some hundreds of hands, and was illustrated with records of how, when and where this or that line was proved correct. In compiling my recent work on hands,[1] I have taken advantage of this, and have set forth in many instances what I copied from the ancient volume, and which I afterward proved by experience to be almost infallible.

Whether the influence that marks the hand be the "subtle essence of the brain," or a still deeper and a more hidden power that "shapes our ends, rough hew them how we will," it matters little. Such agency or influence may forever remain a mystery, but because it does, that does not qualify us for refusing to believe in it, simply because we do not know. One might as well say: "I refuse to live, because I

[1] Cheiro's "Language of the Hand." Price, $2.00. The Transatlantic Publishing Co., New York.

do not know all that constitutes life," or—"I refuse to think, because I do not know the processes of thought."

"As is the mind, so is the form." This is the foundation on which this strange science depends, and whether it be examined from the materialistic or the most mystical standpoint, one cannot help but admit that "progressive specialization of structure" produces suitability of shape, which by study can be classed under various heads dealing with those characteristics common to occupation, surroundings and temperament.

RAILROAD FACTS AND FIGURES.

By Melville Philips.

Here is a fact to astound one—even the reader who may be old enough to vouch for its authenticity: In 1845 (but a half century ago), when only two or three thousand miles of railroad line had been opened in our mother-country, a slender pamphlet of thirty-four pages, bearing, even at that time, the now familiar name of "Bradshaw," was more than sufficient to contain the time-tables of all the trains of Great Britain. In 1842 Queen Victoria refused to travel by railway, and it is recorded of Prince Albert that, in going to Windsor, he was wont to say, "Not quite so fast, next time, Mr. Conductor, if you please." In our own country, many are still living who have watched the development of the greatest railway system in the world, who have seen the steady and amazing advance from Peter Cooper's locomotive, weighing less than a ton, which, with difficulty, outstripped in speed a gray horse, to locomotives weighing more than seventy-five tons, which easily run sixty, and can exceed seventy, miles an hour. Moreover, in the life of the present generation, the railroads in the United States have been quadrupled in mileage; they have attained to the enormous proportions of two hundred thousand miles; they have cost close upon ten billion dollars; they employ more than a million men, and they run more than a million cars, which is to say that stretched out in

a straight line, with locomotives and tenders, they would form a train more than seven thousand miles long.

Such figures convey but an inadequate idea alike of the extent and the advance of railroad interests in the United States. The study, indeed, of the growth of a single great corporation is far more instructive; and so we propose for ourselves, in this paper, a brief consideration of the Pennsylvania Railroad Company, the greatest corporation in the world, the one with which we are most familiar, and the one which lends itself most readily to our purpose of pointing out the several stages of railroad evolution during the past half century. For this company was chartered just about fifty years ago (April 13th, 1846), and from next to nothing it has grown to represent about one-tenth of the aggregate value of the railroad systems of the country; it has more than one hundred thousand employés, and more than eight thousand miles of line laid in so many as fourteen States of the Union. Hence no apology need be made for accepting it as the representative American railroad company.

We have before us an advertisement of the "Pioneer Fast Line," dated April, 1837, which holds out to tourists the alluring prospect of rapid transit from Philadelphia to Pittsburg ("in large and splendid eight-wheel cars," and canal packets), in "three and one-half days." In another advertisement, so late as 1849, the Philadelphia, Wilmington and Baltimore line plumes itself on running twice a day to Baltimore, "through in six hours." This was twenty years after Peter Cooper had built the first locomotive in this country, the boiler of his wonderful engine being the size of a flour barrel, and its flue made of gun-barrels. In a half century there have been very many modifications in the design of locomotives. The modern standard express trains and the heavy freight trains, the light trains on elevated roads and the trains for suburban traffic, require different kinds of locomotives. In size and weight these locomotives have steadily grown, until now the "decapod" class weigh, in working order, one

hundred and forty-eight thousand pounds. The following table, for which we are indebted to an interesting article on "American Locomotives and Cars," written by Mr. M. N. Forney, explains itself:

DIMENSIONS, WEIGHT, AND APPROXIMATE PRICES OF LOCOMOTIVES.

TYPE.	Cylinders.		Diameter of driving-wheel.	Weight of engine in working order, exclusive of tender.	Weight of engine and tender without water or fuel.	Approximate price.	Price per pound.
	Diam.	Stroke.	Inches.	Pounds.	Pounds.		Cents.
"American" Passenger.....	18	24	62 to 68	92,000	110 000	$8,750	7.95
"Mogul" Freight.....	19	24	50 to 56	96,000	116,000	9,500	8.19
"Ten-wheel" Freight.....	19	24	50 to 56	100,000	118,000	9,750	8.26
"Consolidation" Freight.....	20	24	50	120,000	132,000	10,500	7.95
"Decapod" Freight.....	22	26	46	150,000	165,000	13,250	8.03
Four-wheel Tank Switching..	15	24	50	58,000	47,000	5,500	11.70
Six-wheel Switching, with tender.....	18	24	50	84,000	98,000	8,500	8.89
"Forney" N. Y. Elevated...	11	16	42	42,000	34,000	4,500	13.23
Street-car Motor Locomotive.	10	14	35	22,000	18,000	$3,500 to $4,000, according to tender.	19.44 to 22.22

The speed of locomotives has not increased with their weight and size. There is a natural law which stands in the way of this, and it is succinctly stated by the excellent authority quoted above. "If," says Mr. Forney, "we double the weight on the driving-wheels, the adhesion and consequent capacity for drawing loads is also doubled. Reasoning in an analogous way, it might be said that if we double the circumference of the wheels the distance that they will travel in one revolution, and consequently the speed of the engine, will be in like proportion. But if this be done, it will require twice as much power to turn the large wheels as was needed for the small ones; and we then encounter the natural law that the resistance increases as the square of the speed, and probably at even a greater ratio at very high velocities." At sixty miles an hour the resistance of a train is four times as great as it is at thirty miles. That is, the pull on the draw-bar of the engine must be four times as great in the one case as it is in the other. But at sixty miles an hour this pull must be exerted for a given distance in half the time that it is at thirty miles, so

that the amount of power exerted and steam generated in a given period of time must be eight times as great in the one case as in the other. This means that the capacity of the boiler, cylinders and the other parts, must be greater with a corresponding addition to the weight of the machine. Obviously, if the weight per wheel is limited, we soon reach a point at which the size of the driving-wheels and other parts cannot be enlarged; which means that there is a certain proportion of wheels, cylinders, and boilers which will give a maximum speed.

Again, the great improvements in the processes of manufacturing steel, which have resulted in its general use for rails and tires, have made it possible nearly to double the weight which was carried on each wheel when constructed of iron. The weight of rails has also been very much increased since they were first made of steel. A quarter of a century ago iron rails, weighing fifty-six pounds per yard, were about the heaviest that were laid in this country. Now steel rails weighing seventy-two pounds are commonly used, and some weighing eighty-five pounds have been laid on roads in this country, and others weighing one hundred pounds have been laid on the continent of Europe.

One of the most interesting exhibits at the World's Fair was the series of statistical models which illustrated the immensity of the Pennsylvania Railroad Company's business. One large globe, representative of the traffic of the system, showed that its locomotive mileage and passenger and freight movement is equivalent to:—One ton hauled around the world in sixty-three seconds; one passenger conveyed around the world in seven and three-quarters minutes; the locomotive mileage being one hundred and seven million of miles per year, so that one locomotive may be said to travel around the globe every two hours. Another model illustrated the capital invested in the company, and the companies merged into or associated in interest with it. It would require two lines of silver dollars laid, with peripheries touching, along the entire length of its eight thousand miles of road, to aggregate this colossal capital of seven

hundred and fifty million dollars. If each rail in the fifteen thousand miles of track comprised in the system were welded end to end in one long rail, it would reach around the globe and overlap from New York to a point in the Pacific Ocean within about one thousand miles of Honolulu, Hawaii. The amount of stone ballast in the tracks of the system was represented by a model, which, while occupying an equal area, was fourteen times as high as the Pyramid of Cheops; the consumption of coal by the company's lines was shown to be ten tons per minute; the consumption of water, over one million gallons per hour; the daily consumption of oil, three hundred and seventy-five barrels; and, finally, a model illustrating the amount of wages paid to employés from 1857 to 1892 exhibited these robust figures:

YEAR.	ANNUAL PAYMENT.	NUMBER OF EMPLOYÉS.
1857	$1,692,508	3,469
1865	8,614,976	17,149
1870	17,284,105	33,249
1875	23,901,294	46,512
1880	27,860,369	53,303
1885	36,525,347	66,430
1892	57,520,340	104,021

Now all of these facts and figures, though perhaps of sufficient interest in themselves, are set down here because their impressive exhibit at the World's Fair was under the direction of Mr. Theo. N. Ely, Chief of Motive Power, to whom we are indebted for the particular information which constitutes the *raison d'etre* of this paper. That is to say, we propose to give the views of Mr. Ely, as one of the first authorities, on the radical improvements which have been accomplished in railroading during the present generation. These improvements, he tells us, may be classed under three general heads: roadway, equipment. and signals.

Some twenty-five years ago the Pennsylvania Railroad adopted broken stone as best meeting the conditions of a good track foundation; at the same time the dimensions and number of ties were fixed, and finally the rails and turnouts

were laid according to carefully considered rules. The weight of rails has been increased, with a corresponding improvement in fastenings; the old turnouts have given place to those of more modern design; but the foundation is much the same as that first adopted. Closely related to the roadway are crossings at grade. These have, from time to time, been abolished as detrimental to the safe passage of trains.

In equipment, the locomotive has been thoroughly redesigned and made stronger in all its parts. The air-brake, applied to its driving truck and tender wheels, has made it possible not only to stop itself quickly, but assist in retarding the train as well. The strength of passenger cars has been increased until they have reached a weight of twenty-seven tons, and the couplings and platforms have been greatly improved. Sleeping-car construction has likewise advanced, until the more modern cars have reached nearly fifty tons. The air-brake has been indispensable as a condition of safety in fast moving trains.

In the early days of railways there was nothing that could be properly dignified by the name of signals. By slow degrees, as in usual matters involving questions of safety, a high state of development has at last been reached. The best systems of signaling and interlocking are marvels of mechanical skill and ingenuity, and command the respect due to their wonderful efficiency.

It may be interesting to note, in passing, a few instances of train movements which have come under Mr. Ely's observation. Nearly nineteen years ago, or to be exact, in June, 1876, a Pennsylvania Railroad standard locomotive, drawing a train of two sleeping-cars and a dining-car, covered the distance between Jersey City and Pittsburg, four hundred and thirty-eight and five-tenths miles, without a stop, in six hundred and five minutes, or an average rate of forty-three and one-half miles an hour. This journey is noteworthy as the longest known continuous run; and one which involved thorough transportation arrangements for its movement, and great endurance on

the part of the locomotive. The special train was *en route* to San Francisco, which city was reached in eighty-four hours and seventeen minutes after leaving New York.

The train which conveyed President Garfield from Washington to Elberon, September 7th, 1881, was run under conditions of great excitement and anxiety. His life hung upon a thread, and any detention of the train would have resulted disastrously. The excitement was intense, and prostration was imminent. The physicians had fixed upon thirty miles an hour as the speed which would give the least discomfort to the patient. After the train was well under way, and without warning, an increase of speed was determined upon, which reached sixty-five miles an hour before the journey was completed. The order for the transportation of this train was contained in one message, and so skilfully was it worded that, despite the changed conditions, there was not the slightest detention from any cause.

A most noteworthy accomplishment was that of the Pennsylvania locomotive which drew the special train of the Delegates to the International American Conference on their way to the principal cities east of the Rocky Mountains. This engine traversed the rails of twenty distinct lines of railroad, and covered ten thousand miles in its course, without accident of any kind or unreasonable delay.

Another example of endurance may be mentioned—the one hundred and twenty-six thousand miles made by one locomotive between Philadelphia and Washington in the year 1891—equal to five complete journeys around the world.

Mr. Ely's views are of particular interest when he considers what factor will control the limit of speed in the passenger-trains of the future.

In the road-bed, he tells us, we shall have to demand that the alignment be almost free from curvature, and the width between the tracks be increased; that the foundation shall be stable and well-protected from rain and frost; that landslides and other accidental obstructions shall be provided for; that the ties shall be firmly imbedded; that the rails

shall be heavy—one hundred pounds, or more, if necessary —and securely fastened; that all frogs and switches shall be proof against accident, misplacement, or rupture; that all draw-bridges shall be made secure beyond question; and, finally, that all crossings at grade be abolished. It is further insisted that a thorough system of supervision and inspection be provided.

With fulfilment of these conditions which, professionally speaking, are entirely practicable, trains, so far as the road-bed is concerned, may be run in safety as fast as any locomotive can be made to haul them. Of the locomotive, it may be said that only with the improvements in road-bed referred to can its highest attainable speed be utilized.

The measure of the speed and capacity of the locomotive rests in the fire-box, the length and breadth of which cannot exceed certain dimensions. It therefore follows that when this furnace is arranged to burn the maximum quantity of fuel the steam-producing limit will be reached, and with it the limit of speed. But this steam must be used to the very best advantage, as relating to the proportions of the locomotive, as well as to its type; the first of these are already well known, and it will probably be found that some form of compounding will suggest the type. With these limitations, the speed of locomotives with passenger trains will not fall far short of one hundred miles an hour; by which is meant a sustained speed at that rate, as, for instance, a trip between New York and Philadelphia in about one hour, or between New York and Chicago in ten or eleven hours.

As to car equipments, it is probable that, with some change in size and proportions of wheels, journals and other parts of the trucks, the best class of cars in present use would be suitable for the highest speed. They should be made to run as noiselessly as possible, that the occupants may be relieved from any feeling of insecurity or nervous strain. The air-brake should be applied in its best form to both locomotive and cars, so that every pound of braking weight shall become instantly available.

XUM

The above conditions have been cited in detail to show that they all must be fulfilled in order to make possible our future traveling at the rate of one hundred miles an hour. Make possible—but only upon the fulfilment of one other condition, namely, a clear track ahead; and this brings us to the real measure of speed, which is the question of transportation in its strict sense. The limit will vary with the number of trains on the line and with the facilities of handling them. First of all it is necessary to know how soon after receiving warning of danger a train, running a mile in thirty-six seconds, can be stopped. It is estimated that if running at sixty miles per hour, with the full braking weight of the train utilized, and the rails in the most favorable condition, the train could be brought to a full stop in nine hundred feet; at eighty miles per hour, in one thousand six hundred feet; at ninety miles per hour, in two thousand and twenty-five feet, and, finally, at one hundred miles per hour, in two thousand five hundred feet. These figures at once establish the fact that under the best possible conditions the track must be kept clear of all obstruction for at least two thousand five hundred feet in advance of a train running at the highest limit; but we must estimate the clearance for the worst conditions, such as slippery rails, foggy weather and unfavorable grades; the personal equation of the engineman must also be considered in a train covering one hundred and forty-five feet per second.

THE OPERATION OF THE VIBRATORY CIRCUIT.

(By Polar and Depolar Sympathetic Interchange, as Associated with the Transmitter.)

By John W. Keely.

Part I.

I have long held an opinion almost amounting to a conviction that the various forms under which the forces of matter are made manifest have one common origin; or, in other words, are so directly related and mutually dependent that they are convertible, as it were, into one another, and possess equivalents of power in their action. Faraday.

The working part of this device consists, first, of an outside ring carrying on its inside face nine pieces—equidistant from each other—called polar accelerators; which constitute the polar field or polar circuit. Second, another ring of less diameter, situated inside of the larger ring, and carrying on its face eight disks, with a triple grouping in each, representing the depolar field, or field of high polar interference.

In the centre is placed a resonating intensifier, through which the sympathetic currents pass. By a spiro-vibrophonic arrangement these currents are diverted toward the neutral centre of the earth. This device is the sympathetic multiplying agent for the polar field, and the negatizing agent for the anti-polar field. When under action it is entirely subservient to the transmitter, both in regard to high intensification and thorough neutralization of polar and depolar interchange.

The Philosophy of its Action.

The circles containing the sensitized disks—both polar and depolar—are in sympathetic relation to the polar negative circuits of the earth, and in a condition to be brought into action by the negative transmitter. The sympathetic conditions of the polar and depolar field of the circuits remain latent until the transmitter is associated and the introductory impulse given. Then conditions assert themselves which demonstrate the wonderful power of sympa-

thetic action in abeyance to the laws by which they are governed.

The introductory impulse represents the sympathetic chord of unity to polar attraction. When this is given, the polar outreach is immediately established in the polar circuit, which seeks to assimilate itself to the anti-polar, or triple groupings; but as the alternation of the two circuits represents a condition of sympathetic antagonism (as 8 is to 9), an intensified differentiated wave motion is induced between the two, thus developing eight alternations, or waves, to one revolution of the device.

Consequently, an equation cannot be established on account of this negative interference, which represents the power exerted to bring about sympathetic equation between the neutral centre of terrestrial gravity and sympathetic outreach,[1] the power that induces planetary suspension.

Every revolution of the circuits represents eight distinct polar and depolar waves. When the maximum (five hundred revolutions per minute) is reached, there are four thousand polar and depolar interchanges. In sympathetic philosophy the polar circuit represents the brain power of the instrument, or the medium of impregnation from celestial radiating outflow; the depolar circuit represents the organism, which is actuated to do the sympathetic work as dictated by the same power, or element,[2] that virtually oper-

[1] The sympathetic outreach of the moon toward the earth has a power strong enough to extend nearly a quarter of a million of miles, lifting the oceans out of their beds. The action of the magnet may be compared to a sympathetic outreach of a very limited range of motion. It is quite foreign to induction in principle, and may be expressed as "seeking for concordance to establish an equation on the sympathetic disturbance of equilibrium."

[2] The substance of the brain is molecular. The mind which permeates the brain is inter-etheric in substance; it is the element by which the brain is impregnated. This element, when excited into action, controls all physical motion as long as the necessary sympathetic conditions are maintained. These conditions are no more immaterial in their character than are light and heat. Electricity, magnetism, gravity, and heat are latent in all aggregations of matter. They are not obtained from terrestrial influences. Celestial radiation is the true impregnating medium in all these forces. The brain is the high resonating receptacle where the sympathetic celestial acts, and where molecular and atonic motion are induced, as according to the intensification brought to bear upon it by radiation.

ates our physical organisms; the work done representing the power expended to equate the power transmitted, although the movements in the physical organism are much more complicated.

The polar flow, as induced by the transmitter, is intensified or diminished by an oscillating bar which governs the revolutions to any number without variation.

The aerial propeller has a sympathetic polar accumulator and disperser in one instrument, which is entirely distinct from any of the devices intended for terrestrial use; also other mechanical adjuncts not needed on land nor water.

All forms of non-sympathetic machinery have, associated with them, conditions of centrifugal force on the ratio of the velocity induced; the diverging power from the centre of induction being governed specifically by its gravital weight according to the diameter it occupies in its circle of rotation.

In a sympathetic negative circuit this order of conditions is reversed; for the power of neutral attraction draws the molecules of any mass, no matter what the weight, toward the centre of rotation (instead of toward its periphery) according to the intensity of the negative vibration that is induced upon that particular circle.

Our earth, in its routine of revolution, is governed by the same law in every particular; its mass tending toward its centre of neutrality with a force that is equivalent to the character and velocity of its rotation.[1] If its rotation were increased, the tendency of everything associated with it would be increased toward its centre of neutrality on the same ratio. That is, a pound in weight would, under certain conditions of increased velocity, become two pounds in weight. The laws governing the sympathetic rotation of vibratory machinery are the same laws that govern planetary suspension. To those who have not witnessed the operation of my devices, my theories must indeed seem wild; but the laws of nature are the same yesterday today and forever. They know no change; and sympathetic

[1] *Vide* Dr. Robert Hooke's theory, advanced by him in 1674.

physics, demonstrated mechanically, must triumph over all ridicule and opposition in the end. To contradict the laws governing sympathetic rotation is to contradict the laws governing planetary suspension, as I am prepared to demonstrate.

If the earth were rotated on a shaft by mechanical force, the present condition of its rotations would be reversed; everything on its surface would fly off at a tangent, on the ratio of the velocity induced. The equilibrium of all things would also be changed.

The gyroscope reveals astounding facts in relation to this philosophy, even when operated mechanically. No other known device is so nearly associated with sympathetic vibratory physics.

The vitalization of the disks for the polar and depolar field is established on the ratio of thirds, sixths, and ninths; the ninths being the circuit occupied by the polar field, must represent, in the scale of vitalized focalized intensity, 100 in my system: sixths in the depolar field, or $66\frac{2}{3}$; and in the neutral field, or thirds, $33\frac{1}{3}$. The triplets must represent one true chord of equation. The sympathetic transmitter transfers any degree of intensity desired from zero up to disintegration; all the transfers being made above the line of the first inaudible, as associated with my resonating system of transfer. On the sixths and ninths, in the progressive triple subdivision of the elements[1] of water, the nearest sympathetic approach is made to the high luminous, which is the main sympathetic link to the earth's polar negative envelope, and the one whereby coordination is effected for commercial work. In short, this progressive condition establishes the necessary association

[1] The only indivisible "element" is the luminous, the one from which all compound elements are formed, or aggregated; hydrogen being one of these compound substances. If hydrogen were a simple it would assimilate with the high luminous. No molecular structure known to man can hold even the low order of the luminous as chemically liberated. Sympathetic physics classifies hydrogen as a compound triple element, with a metallic base. It comes under the order of the second atomic, both in vibration and in sympathetic outreach.

between celestial radiation and terrestrial outreach, in regard to controlling the polar negative attractive force in mechanics; whether for aerial navigation or for terrestrial commercial work, in all its multiplied forms.

The atmospheric envelope of our earth owes its activity and its volume entirely to celestial radiating forces.[1] Reception and dispersion are kept up by atomic and inter-atomic conflict between the dominant and enharmonic currents of the triune polar stream. The harmonic and enharmonic current with the dominant (in the electric stream) by their sympathetic association evolve the energy of matter.

The mechanical proof of the correctness of my theories, in sympathetic or spiritual physics, is so overwhelming in its simplicity that it needs but to be witnessed to convince the most learned or the most simple mind that this system will place both science and commerce on a platform which will elevate each to a level far higher than those they now occupy.

Part II.

THE NEUTRALIZATION OF MAGNETS.

Thus, either present elements are the true elements, or else there is the probability before us of obtaining some more high and general power of nature, even than electricity, and which at the same time might reveal to us an entirely new grade of matter, now hidden from our view and almost from our suspicion. FARADAY.

Question. How can a magnet be robbed almost instantaneously of its magnetic power?

Answer. The peculiarity of the sympathetic conditions which conserve a magnet to polar and anti-polar currents of the earth, prove perfect sympathetic equation between reception and distribution in that part of the electrical field which is classified, in my system, as inter-atomic vibratory oscillation.

This oscillation represents, in its corpuscular field of action, an alternating wave-motion of one hundred and

[1] "There is more in the great realm of electricity than mechanical force." —Wm. Hemstreet.

twenty-eight thousand four hundred vibratory exchanges per second, between polar reception and depolar distribution, thus establishing its perfect sympathetic concordance to that third of the electric triple stream which represents the sixths in vibratory sympathetic physics. The sympathetic action of the magnet, when electrically sensitized, becomes subservient to polar attraction as a medium through which a portion of its flow is diverted; no longer latent, but highly active as long as its magnetic sympathy (as electrically induced) continues, and it will then associate itself with every medium in nature in which this element exists in its latent state, from steel to oxygen at a low temperature.

We have now reached a starting-point from which to obtain a conception of the manner in which a magnet can be neutralized, that is, robbed of its coincident unity, or subservience to polar negative attraction.

The vibration of the polar magnetic flow represents one hundred and twenty-eight thousand four hundred oscillations per second, or one-third of the triplet of electrical induction, consequently the magnet must be in pure concordant sympathetic union with this rate of vibration, in its polar field, to become a medium of receptiveness as well as a medium of distribution of polar negative sympathy. In other words, the polar sympathetic flow is tapped at this point to allow of a letting out of the focalization that is diverted toward it by electrical vitalization[1] which represents positive negative concordance.

If a condition of antagonistic vibration is brought to bear upon this focal centre—the magnet—its concordant sympathy to the polar sympathetic volume is broken up, inducing sympathetic dissociation; which means positive neutralization, as far as its latent energy can be disturbed or diverted from receptiveness and distribution.

The magnet can be compared to a dark room without one aperture to admit a ray of light. The one hundred

[1] "Electricity is a beneficial fairy. With infinite tenderness she offers to yield up to you her treasures from unexplored portions of her domain."—M. Alfred Picard's speech before the Syndicate of Electricians, in Paris.

and twenty-eight thousand four hundred vibrations represent an aperture, illuminating the room with a constant flow of sunlight. The negative vibrations represent a condition whereby the closing of this aperture is effected, cutting off the flow of light:—the sunlight representing polar energy.

All vibrations that are negative in their character as toward destroying the harmonic relations that exist between the magnetic current and its coincident polar, to carry out the simile, close up the aperture whereby illumination (or transfer) is continuously conducted.

The thirds, on the subdivision of the one hundred and twenty-eight thousand four hundred vibrations, represent the negative antagonism, whereby this peculiar condition is brought about, *viz.*, forty-two thousand eight hundred on the positive; the same on the negative and on the neutral, as associated with the sympathetic negative transmitter.

The keeper is first placed on the magnet, which has an attachment whereby a transmitter can be centrally associated with it; the other terminal having three connections that can be attached to this medium. The impulse is given simultaneously to the three leads after setting the instrument to represent forty-two thousand eight hundred vibrations on the harmonic, the same on the enharmonic and on the diatonic.

If this impulse is given properly, the neutralization will take place within fifteen seconds.

The original instrument whereby this condition was first brought about is not used in my completed system. Thorough sensitization as well as complete neutralization are now effected by the improved polar negative transmitter without attaching the magnet. The combination, of devices which make up the propeller of the air-ship, includes every feature of this system relating to the varied governing conditions of celestial and terrestrial sympathy.

The series of experiments, daily for one week, that I am now preparing to give before an expert committee, for the purpose of enabling this committee to make a public an-

nouncement of the scientific and commercial value of my system of sympathetic vibratory physics, comprises:

First.—Operation of the polar circuit, drawing power from space, and showing control of various degrees of velocity.

Second.—Sensitization of a polar disk, after having had its complete neutrality to magnetism tested.

Third.—After associating it with the polar test-medium, heavily weighting it to demonstrate its attractive power; the weight remaining suspended to it by this power.[1]

Fourth.—Transmitter connected to the test-medium, while the disk is carrying the weight. Negative vibration transferred; effecting complete dissociation; the disk and weights dropping to the floor.

Fifth.—Rotation of compass-needle, on a set of resonators, subservient to any one of the resonators, in defiance of its attraction to the north. Variations given; changing its subservience to different resonators, as the introductory impulse is changed.[2]

Sixth.—Mediums, representing the chords of different masses of metal, made to float in a tall jar of water, with extraordinary changes of position.

Seventh.—Operations of a sensitized globe, by sound.

Eighth.—Operations of the globe under the influence of the improved polar sympathetic transmitter.

Ninth.—Disintegration of water by triple vibration,[3]

[1] It was a modification of this experiment witnessed by Professor Rowland which led him to proclaim that he had detected Keely as using a tube instead of a wire. I have retained a piece of the wire cut by Prof. Rowland on that occasion.—C. J. M.

[2] It was this control of the compass-needle and raising without contact weights of eight pounds, in insulated glass jars, which caused the late Professor Joseph Leidy and Dr. James Willcox of Philadelphia, with other men of science, to say in 1889 that Keely was then on the road to the solving of the problem of aerial navigation.—C. J. M.

[3] This is the experiment which Lord Kelvin and Lord Rayleigh were invited to witness in 1884, but were prevented (after Mr. Keely had taken apart his instrument to show them its interior construction) from representations that were made to them by Philadelphia men that Keely was believed to be a charlatan.—C. J. M.

showing progressive degrees of energy (from molecular to inter-atonic, etc., etc.) on different rates of transfer.

The full operation of the aerial propeller, in a variety of features of action, will be shown if the connection has been effected between it and the sympathetic harness.

A concave steel shield for the reception of the corpuscular inflow toward the neutral centre of the propeller is the medium whereby great velocity through space will be attained. Forty-two thousand vibrations per second is equivalent to a ten thousand pound push. This force can be regulated from three hundred pounds to five tons, which is the maximum speed. The minimum at eight thousand vibrations is three hundred.

THE VEIL WITHDRAWN.

COMPILED BY MRS. BLOOMFIELD MOORE.

We shall yet seek to raise the veil and to penetrate into the secrets of things.
H. T. BUCKLE, 1836.

Such insight as this system ventures to give is generally regarded as unattainable. The tidings which it brings, it will be said, are too good to be true. Meantime, so far as we have gone, it represents nature. And thus the winter carries the spring in its bosom, and in the ruins of old systems new ones are provided for. MACVICAR, 1860

True philosophy, when reached, said Professor George Bush, will conduct us into the realm of the spiritual as the true region of causes, and will disclose new and unthought of relations between the world of matter and of mind.

It is these *unthought of* relations which Keely's system of sympathetic physics brings to light; opening out a field for research which lies beyond the boundaries of our present knowledge. As yet he has been unable to satisfy his own penetrating mind in regard to all the hypothesis which his various discoveries have led him into formulating. He has himself, in his search for truth, pursued the wrong path too often, and made too many errors, not to welcome refutation of them, and acknowledge his mistakes when brought before him.

The title which he has given to the latent current of the triune polar flow that he discovered in 1872, "polar negative attraction," undoubtedly conveys the idea that this flow is an agent closely allied to magnetism; but such is not the case.

This latent element exists in the interstitial conditions of all nature's triple streams of force; in electricity, in magnetism, in gravity; and is the dominant current in each of these, maintaining a sympathetic relation to the high or compound luminous, which manifests itself when the proper mechanical requirements are used. It is entirely foreign in character to the elements now in commercial use. Researchers will always find before them a limitless beyond, comprehended only by the Infinite One.

What modern cosmologists would have us believe was evolved by blind chance out of the inherent potentialities of primordial chaos, this glorious system of spiritual physics demonstrates as dependent upon the relationship between mind and matter; showing whence the initial impulse comes which sets in motion machinery of unimagined complexity, on given lines, toward a prescribed end. Chance, as has been said, is in no sense a force, but merely the sway of a balance of forces already in action. Sir Isaac Newton taught that there is such consistency in nature that what lies wholly beneath the region of visibility may be safely inferred to be similar to that which is gross enough to be palpable to sense; and Keely, reasoning on this line, has copied nature in his mechanical work. "I call this indefinable, latent element," he writes, "the soul of the sympathetic elements in which it manifests itself; and which until now has been locked up in their interstitial embrace. It is the leader of all triple streams, associated with the polar negative envelope of our planet and the one most sympathetically concordant to celestial radiation. In our individual organisms, the latent soul-forces, existing in the cerebral domain, are sympathetically subservient to the celestial radiating force whereby they are stimulated into action in controlling the movements of our bodies. Take away this

latent element from the brain and the physical organism becomes an inert, dead mass; on the same order as a mechanical device without an energy to operate it.

"The polar negative machine is a mechanical brain, with all the adjuncts associated with it to sympathetically receive and distribute the polar negative force. Its sympathetic transmitter" (corresponding to our sun in our planetary system, transmitting all energy from the central sun of the universe) "is the medium whereby sympathetic concordance is established between it and polar sympathy. The requisites for polarizing and depolarizing keep up the action of the machine as long as it is associated with the transmitter. The force which operates the mechanical is the same as that which operates the physical brain; purely mental, emanating from celestial outreach. There is nothing in the range of philosophy which so satisfies the intellect as the comprehension of this wondrous system of sympathetic association, planned by the Creator of the celestial and terrestrial universe, for the government of all forms of matter.

"Nature cannot rebel against herself. The flowers of spring cannot resist the sympathetic force which calls them into bloom, any more than the latent force in intermolecular spaces can rebel and remain in neutral depths when sympathetic vibration calls it forth.

"What is the soul but life in latent suspension? The motion exhibited in matter shows that its soul is ever present; and yet there are men of great learning, as taught in the schools, who, after spending their lives in researching all forms of matter, deny that all living things depend on one everlasting Creator and Ruler, in whom they live and move and have their being through all time, as much as when He first breathed into them the breath of celestial radiation; and to whom they are as closely allied, still, by the workings of the great cosmical law of sympathetic association, as when the evolutionary work of creation commenced.

"The ancients were far better schooled in spiritual philosophy than are we of the present age. Their mythological records, in their symbolical meaning, prove this fact. They

recognized this latent element as the very breath of the Almighty; the sympathetic outflow of the trinity of force, the triple spiritual essence of God Himself. Their conceptions of Deity were greater and truer than our own. From them we learn that when God said 'Let there be light,' He liberated the latent celestial element that illuminates the world: that when He breathed into man the breath of life, He impregnated him with that latent soul-element that made him a living and moving being."

Thus we see that true science has at last—as the result of Keely's half century of research—a sure basis for knowledge, in the resolving of the numerous so-called laws of nature into one universal law, explaining the grandest and most prevailing phenomena of the material universe—phenomena which have hitherto set at defiance all attempts to conceive a mechanism to account for them, and which Abercrombie declared, in his "Inquiries Concerning the Intellectual Powers," to be beyond the reach of the human intellect to explain.

By the knowledge thus revealed—for, as Moreau has said, "Knowledge does not come to us by detail, but in flashes of light from heaven,"—we realize the truth of Sir John Lubbock's words that "the great lesson which science teaches is how little we yet know;" but we learn also that there are no boundaries to the life of the soul; that the soul is the principle of life itself, the latent element which connects us with the Infinite and Eternal One from whom all things proceed; and that in God's life we live and move and have our being.

Vibratory physics, in the great cosmical law of sympathetic association, explains all phenomena of nature, and demolishes the barrier that skepticism and materialism—working together toward a reign of anarchy—had erected between matter and spirit, in proclaiming that the soul dies with the body, that nature rows and steers her own canoe; denying that there has ever been such a thing as revelation, or that there is any proof of design in the works of creation; and teaching that efficient causes are beyond our reach, that we must be satisfied with the knowledge of the facts and their

actual connection—as we observe them—without trying to trace the events on which the connection depends.

Lord Salisbury recently said of the cloud of impenetrable mystery with which science covers phenomena that she cannot explain: "If we strain our eyes to pierce it, with the foregone conclusion that some solution is and must be attainable, we shall only mistake for discoveries the figments of our own imagination;" but as long as we have men able to guide an intelligent public inquiry, who "have no prejudices except in favor of men who do honest and self-sacrificing work in new fields,"[1] there is still hope that Keely's discoveries will command that interest which will save them for science to this age; even though not available to commerce in this century, as is now anticipated.

Surely with this new revelation of "unthought of relations between mind and matter," the universe lies before us as a legitimate field of knowledge; where researchers will be able to occupy themselves with facts and observations tending to explain and demonstrate the manifestations of the spiritual principle, life itself, without having these investigations confounded with those of mere metaphysicians, who dwell in the region of abstract ideas, and endeavor to reduce them to the clearness of mathematical axioms.

Next to being on the right road, the most fortunate thing that can happen to the searcher after truth is to find out that he is on the wrong road. Leaving the central basis and facts of humanity as too vast and unmanageable, science has been working in "the huge, vicious circle" of Comtian philosophy; until, arriving at its farthest limit from the center, it has reached, says Carpenter, "the outermost shell, as it were, of the great Mancosmos; and now, to their great surprise, it finds that this shell is not entirely osseous." Savants are forced to acknowledge that, if deprived of one of the crutches which science has been leaning on, natural selection, they have no resource but to fall back on the mediate or immediate agency of a principle of design.

Stanley Jevons, in "Principles of Science," expresses his

[1] Mr. Arthur Walter of *The Times*.

strong conviction that, "before a rigorous, logical scrutiny, the certainty of our scientific inferences will prove, to a great extent, a delusion."

If, at this juncture, a physicist could be found bold enough to turn, in the face of dogmatic science, to Keely's system of sympathetic vibratory physics, he would touch the solution of hitherto unsolved problems set down in a language as incomprehensible, to him, as was the language of Dr. Gilbert (the rediscoverer of electric force) to his compeers; and even more so than that of Faraday, of whom the same complaints were made, in his writings, wherein he differed in opinion from his colleagues.

Says Lord Kelvin, there is a still greater mystery than any which is to be found in connection with any physical science, and that is the mystery of the human will.

Celestial radiation unveils this mystery. The cosmical law of sympathetic association gives to science an atom that will suit the requirements of both chemist and physicist. The ether hypothesis of vibratory physics answers as well for the vehicle of gravitation as for the vehicle of light; and is equally available for gravity, electricity, and magnetism.

If men of science fail to comprehend the terms which Keely has had to coin, the language in which he has done his best to convey to them his meaning, the great book of nature lies before them—available to all—from which he has gained his knowledge of the divisibility of the atom, of latent force in all interstitial spaces, and of the governing law of sympathetic association. He has put together, in regular method or order, full and connected hypotheses of the operations of these laws of nature in the system which, if incomprehensible and unworthy the attention of "The Lights of Science," will not be so at the end of this century of progress; should its crowning achievement be that of solving the problem of aerial navigation.

Some individuals, says Colquhoun, may be more, while others are less, capable of deciphering the characters in which the book of nature is written, and of comprehending and duly appreciating the truths it reveals. But, if we would peruse

it with advantage, we must shake off all prejudices and not cling to preconceived notions. The skepticism of science repels, with too much contempt, the investigation of phenomena which it deems impossible or inconsistent with its cherished systems. There are no barriers so detrimental to the progress of real and useful knowledge as the prejudices of self-satisfied and exclusive men of science.

Buffon, treating of the sympathies that exist between the different parts of the living organism, censured medical men for not examining their correspondences in the human body, upon which depend a great part of the play of the animal machine. "The true springs of our organization," he said, "are not these muscles, these arteries, these nerves, which anatomy describes with so much care and exactness: there are internal forces which do not follow the laws of that gross mechanical system which we have invented, and to which we would reduce everything. Instead of attempting to attain a knowledge of these forces from their effects, men have endeavored to banish even the idea of them, and to exclude them from philosophy.

"The ancients, whose genius was less limited and whose philosophy was more extended, wondered less than we do at facts which they could not explain; they had a better view of nature, such as she is: '*A Sympathy*,' a singular correspondence, was to them only a phenomenon, while to us it is a paradox, when we cannot refer it to our pretended laws of motion. Let us, with the ancients, call this singular correspondence of the different parts of the body '*A Sympathy*,' or, with the moderns, consider it an unknown relation in the action of the nervous system; this sympathy, or this relation, exists throughout the whole animal economy, and we cannot too carefully observe its effects, if we wish to perfect the theory of medicine. Much might be discovered, if the most eminent physicians would turn their attention to the study of this relationship, more useful, perhaps, than the nomenclature of anatomy.

"The medical student applies himself to the indispensable study of the mere animal mechanism, and to the uses and func-

tions of the material structure, which is essentially necessary:—also he studies chemistry, *materia medica* and pathology; but the success of professional practice depends upon the skilful application of a profound knowledge of the various sympathies and susceptibilities of the human frame:—its capability of being affected in various ways, by those imperceptible physical and moral influences whose existence is constantly manifested in the living body; but which we should in vain attempt to detect or trace in the inanimate subject. Yet men of science betray an obstinate skepticism with regard to the result of all such inquiries, and a propensity to call those physicians "quacks" who are engaged in them. Until their researches are extended, in this direction, medicine can never become a science; it must remain an art. Van Helmont was fully aware of the powerful influence of the mind on the body; but since his day few eminent men have studied the sympathies existing between the different and distant parts of the animal economy, through the mediation of the nervous system; and those who have, like Dr. Alison and Dr. Monro, arrived at different conclusions regarding the possible source of this sympathy. If the nerves have cavities, as has been surmised,[1] these mutual sympathies are easily explained on the ground that they secrete and transmit some substance.

"Whether the nervous system be intended to serve other purposes in the animal economy, it is certain that it is intended to serve the grand and essential purpose of maintaining the connection between mind and body. Whether these sympathetic actions originate from a connection between the different nerves, which are the sole instruments of all sensations; or whether they are determined by mental sensations; these are questions to be decided by scientific physiologists and physicians."

By combining physical physiology with mental, a path is opened in Keely's discoveries for the solution of all problems

[1] "Is there something within molecules independent of them that is the home of life, mind, and soul? We find the most complete telegraphic system in the body; does it contain no resident nerve fluid to fit it?" HEMSTREET.

in this field of investigation. The late Professor Zerfi held, with Dr. Bertrand, that the *plexus solaris* performs the same functions in relation to the internal life that are ascribed to the brain as the organ of the intellectual faculties (in the waking state) in relation to the external life.

The ancients called the solar plexus the *cerebrum abdominale;* believing that the soul derives from it the materials necessary for the formation of its intuitive judgments.

"We have yet much to learn before we are able to comprehend the wonderful operation of the imperceptible agents of nature, and of all the instruments we can employ," says de La Place (the disciple of Newton) "the nerves are the most sensible; especially when their sensibility is exalted by particular causes. It is by means of them that we have discovered the slight electricity which is developed by two heterogeneous metals. The singular phenomena which result from the extreme sensibility of the nerves, in some individuals, have given birth to various opinions relative to the existence of a new agent, which has been denominated animal magnetism, also to the action of terrestrial magnetism; to the influence of the sun and moon in some nervous affections; and to the impressions which may be experienced by the proximity of a metal, or of running water. It is natural to suppose that the action of these causes is very feeble, and that it may be easily disturbed by accidental circumstances; but, because in some cases it has not been manifested at all, we are not entitled to conclude that it has no existence. *We are so far from being acquainted with all the agents of nature, and their different modes of action, that it would be quite unphilosophical to deny the existence of the phenomena, merely because they are inexplicable in the present state of our knowledge.*"

The lines of research pursued by the eminent physicists, William Crookes and Oliver Lodge, have brought them to the same conclusion that Camille Flammarion has arrived at in his studies, *viz.*, that certain natural forces exist of which humanity is ignorant; which makes it the more remarkable that they have not been able to find time to examine into

Keely's demonstrations of the power of will force in machinery, under given conditions.

Raoul Pictet, the learned Swiss physicist whose researches in low temperatures (in the very domain of sympathetic vibratory physics) have brought him out of the "impenetrable cloud," in which materialistic science has wrapped the mysteries of nature, into the light of religious science, after listening to a "wholesale" condemnation of scientific research from a Roman Catholic Bishop, said to him: "Have you ever seen God?" "Of course not," the Bishop answered. "Then I have this advantage as a researcher of truth over theologians," replied Professor Pictet," for the longer I study the phenomena of nature the more distinctly I see God in all of nature's operations."

When Edison was asked: "Do you believe in a personal God?" "Certainly," he answered, "the existence of God can, to my mind, almost be proved from chemistry."

"The reason of skepticism and unbelief is not to be wondered at," writes Thornton, "when men interested in scientific research find no evidence, from their experiments, of the presence of God in the Universe. How could this be otherwise? God has to man but a subjective existence, which could never be reached by any known mode of experiment; therefore man must get outside of himself, which means that he must 'die,' to know God and the reality of things.

"In the creative power of intuition we must look for a knowledge of what is called the supernatural; and in this alone we have the evidence of infinity; to which inventive genius can testify, as intuition creates those things which have no material existence. The infinite power of God creates a thing, without previous existence, by command; and man brings into existence, through material, that which his intuition creates. Intuition is the only possible source that could furnish us with the ability to formulate mentally an absolutely unconditioned ego. In fact, absolute knowledge can never be obtained outside the sphere of intuition, for which we are indebted to the gestation of thought. Relative knowledge belongs to experience as well as intuition.

The law of heredity teaches that mental and morphological impressions are transmitted to the offspring from the sexes. In the same way intuitions arise from the gestation of thought, the continuity of which is transmitted by the same means, and for which we are indebted not only to our parents, but to all our progenitors. He who possesses genius can emit coruscations from the gestation of thought which are the evolutionary flashings of a spiritual essence." "Origin, Purpose and Destiny of Man," by Wm. Thornton.

As a subject which does not admit of verification by the prescribed canons of mechanical physics is held to be unworthy of attention, as untenable, it is fortunate for the cause of humanity that modern science has reached its *ultima thule*, where the tide of materialism must set back and carry with it the drift-wood of skepticism which has been accumulating during this century.

To quote the words of a physicist (at the Forest Gate Physical and Chemical Laboratories), "The door, between us and the spirit-world, which it has been declared is shut and bolted is even now ajar and a few gleams of light are struggling over the threshold from Keely's discoveries."

The artificial beacon, fed with the oil of learning, so proudly held aloft by modern science, is flickering; and many great minds are rebelling against the darkness in which it has plunged the mysteries it sought in vain to unravel. The Popery of scientific authority must have its downfall now that researchers after knowledge are making a stand and contending their right to think for themselves, instead of allowing dogmatic science to decide for them.

There is a light which sympathetic physics teaches us will never fail:—the inner light, or intuition, if we seek its guiding rays. The Spirit of Truth will lead us into all truth is the promise given by One who spake as never man spake before; and, with the foundation stones of pseudo-science crumbling away, there is nothing left to fall back upon but the fortress of Revelation.

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"In the beginning was the Word (*Logos* in Greek; the divine principle of Truth, of thought, intelligence, knowl-

edge) and the Word was God. In Him was life, and the life was the light of men. And the light shineth in darkness and the darkness comprehendeth it not."

Carlyle defined genius as "the clearer presence of God Most High in a man." If we admit that

> "God sends His teachers unto every age,
> With revelations fitted to their growth,"

instead of rejecting what seems to advance thought to be "a fuller revelation of revelation" (suited to the needs of our age) because of the obscurity of the language used by Keely, would it not be more rational to accept Professor Pierson's views? *viz.*, "the very fact that there is, about the product of another's genius, what you and I cannot understand, a proof of a superior order of faculties." No one who has ever conversed with Keely, in an unprejudiced spirit, has denied that he is a man of genius; and, unintelligible as his writings may be, in the present state of our knowledge, the time will come when they will be as well understood as are the writings of Gilbert and Faraday now; for commerce will be able to accomplish what science refuses to do; and journalism is already extending "a helping hand," since it has been announced that Professor Lascelles-Scott thinks aerial navigation will be the *fait accompli* of the Victorian era, as the result of Keely's discovery of the force foreshadowed by Faraday, by Newton, and by Kepler in their writings, as "a force of nature, still unknown, more general and more powerful even than electricity."

This force may be in more senses than one "the force of the future;" for, until the current now harnessed has been connected with some patentable device, commerce will not come to the rescue; and unless a more general public interest is awakened, than has yet been manifested, Keely's system of vibratory physics may have to await a more enlightened inquiry from influential quarters.

A distinguished physicist, who is himself an independent researcher, writes; "I am afraid that making things known to the public does not advance truth much. They will soon enough run after what pays them. I should have thought

that, at the present stage, 'They also serve who stand and wait,' was a safer motto than 'Cry aloud from the house-tops.' If Mr. Keely be perfecting his machine, having, as I understand, practically completed his experimenting, surely it is a time for waiting patiently for the results of his labors. However, it is presumptuous and absurd of me to be writing of these things. I know much too little of the circumstances to do more than make suggestions in order to get information."

As no authoritative announcement of what has already been accomplished can be made until certain arrangements are effected, every effort has been put forth to induce men of science to investigate Keely's system, and his demonstrations, in order to aid in the protection of his discoveries for science; and to "hold the reins," in that domain, until his devices, or machines, are in readiness to hand over to commerce what legitimately belongs to the realm of commerce.[1]

The extreme simplicity of this system, its conformity to nature, and its capability of affording an adequate and satisfactory explanation of the most important phenomena of the universe, upon one common principle, entitles it to receive the attention of all independent thinkers who feel an interest in the discovery and dissemination of scientific truth; and who, dissatisfied with the complicated structures which modern science has reared upon a variety of gratuitous assumptions, seek to withdraw that veil (hitherto deemed impenetrable) which has long shrouded some of the most important secrets of nature, and concealed from our knowledge the operations of the most god-like element in man, the human will.

[1] Happily, since this paper was written, the current of force has been connected with the operation of machinery, other than the wheel which harnessed it as it were; and Keely is now preparing to demonstrate the result to a committee of expert engineers, who will soon report upon the commercial value of this costless power. What science has rejected, commerce will now be eager to accept, when Keely has demonstrated "a sympathetic force of outreach representing, in the full circuit, an accumulation of gravital or polar sympathy of more than twenty-three tons per minute." "This is no fairy tale," Keely writes, "but an accomplished fact, capable of being fully demonstrated," to the committee.

ARE PHYSICAL AND SPIRITUAL ENERGY IDENTICAL.

By Mrs. Mary Parmele.

Whether science turns its glass out into the immensities of space, or in toward the equally fathomless abysses of the minute, there seems no bounds to the possibilities of discovery regarding the processes of nature. Yet each and every pathway leads at least to impenetrable mystery.

What use to know of the ultimate molecule and atom, if we are never to learn what endows it with life. What is life? What is death? What is pain? What is color? Perfume? What is there in a minor chord to make one weep? Thousands of hungry eyes are peering into the dark in search of clues to these encircling mysteries. But a little rift has appeared in the veil, through which some think they can see a great and illuminating truth. This truth is called sympathetic vibration.

A new era dawned, we passed under a new scientific dispensation when heat and light were pronounced simply modes of motion, and when the hitherto solid earth was found to be only seemingly so, while in reality it is a congeries of whirling atoms. Under this new dispensation the door hiding those two baffling mysteries, matter and force, begins to yield. The former has surrendered its secrets down to the ultimate atom, and now we are told that energy, that inscrutable thing which makes matter its slave and plaything, is simply a mode of motion in the atom.

The initial impulse is still as remote as ever. We have not yet discovered on what our tortoise stands. What imparted the first movement to the atom, may be an ever receding mystery; but an enormous advance has been made upon the outlying territory. Science has gone one generation farther back in the pedigree of energy; for the law ot sympathetic vibration must be the *Law of Laws.*

We are told that what we have known as sound, heat and light are simply ascending stages of increasing rates of velocity, in atmospheric or etheric atoms. Between sixteen a second and thirty-eight thousand a second these vibrations are appreciable by the human ear, and we call them *sound.* As the rate of velocity increases these are lost in silence, and finally reappear to the sense as *heat.* Then, after they are further accelerated, the optic nerve begins to tremble at their approach, and we call them *light.* Nor can we suppose this to be a final limit, but must believe that, accelerated to still higher velocity, they may reach us in some new form, which to man's perception, at least, is not sound, nor heat, nor yet light, and which, perhaps, we call electricity.

But this protean thing, it will be observed, is one and the same throughout. It is energy, evolved into higher and higher forms, under the action of the law of vibration. Nor can we stop here. What right have we to suppose that the stage bounded by our perception is final? Much more easy is it to believe that the process goes on, and forces are developed as far beyond electricity as electricity is beyond our starting point, sixteen vibrations a second; and so we are inevitably led to a conception of potential energies lying all around us, sufficient to hold the stars in their courses, or to tear them from their orbits.

Thus far we are standing on solid scientific ground. He who doubts this ascending ladder of energy, arrays himself against so high an authority as Prof. Tyndall. But we are going to venture soon upon a region where the footing is not so secure; and perhaps may be properly rebuked for the folly of attempting to map out the highways and byways in cloudland.

There is an unwritten law that science is for the scientific. This article is a protest against this law. The writer is speaking for the unlearned, "of whom she is chief," and she maintains that there can be no exclusive ownership in established scientific truths; which may, and should, be used as stepping stones by any one, where they seem to lead to higher inclusive truths.

XUM

The average man of science is intent upon his own particular rung, and his soul is little vexed with wondering where the ladder leads. Scientific imagination is not always the companion of the microscope nor of the crucible. But Newton's discovery would have been a small affair without the genius to see its cosmical application. So there is a stage in the unfolding of natural truth when the poet, with his wings, can do more than the delver with his pick-axe. He does not discover, he *divines*. Shakspeare knew nothing of "vibratory physics," nor of "ultra-musical silence;" but two hundred and fifty years ago he said:

> "There's not the smallest orb, which thou beholdest,
> But in its motion like an angel sings,
> Still quiring to the young-eyed cherubim.
> *Such harmony is in immortal souls.*
> But whilst this muddy vesture of decay
> Doth grossly close us in, we cannot hear it."

We sometimes wonder at the admirable docility with which the unlearned accept mystifying explanations. After being told that things act so and so because they have an "affinity" for each other, they feel that there is no more to be said. The question is answered. One mystery has been explained by another. But now we are on the track of this inscrutable "affinity."

Every atom behaves as it does because of its essential nature. It is not helplessly drifting in space, waiting for stray streams of energy to gather it up and determine its fate. It has an attribute which compels it to find its own place in creation. It has inherently a certain rate of vibration, and an impulse to join others constituted with a like rate of velocity or one numerically allied to it. This tendency, this sympathetic hunger, is "affinity." Oh, the depth of meaning in those words, "sympathy" and "affinity!" They are the world-builders, the creative agents which brought order out of chaos.

For an uncomprehended reason, atoms have arranged themselves according to their numerical affinities. Those with like velocities of a certain kind were drawn into close

union and became rocks. Others singing a different rhythm came together in less stable combination, and are gases. And so down to the minutest classification of matter, all has been arranged by the compelling law of sympathetic vibration.

It is a well-known fact that when a musical note is sounded over a piano, all the strings attuned to the same, or to a numerically related number of vibrations, will sing in response. This is "sympathetic vibration."

The reason the string gives audible response is because its molecular condition has been sympathetically stimulated to activity. This activity is of course a manifestation of energy, and according to Mr. Lascelles-Scott (Physicist at the Government Laboratories, at Forest-Gate near London,) and other competent observers, this energy is often sufficient to tear the atoms apart; as illustrated by the breaking of a glass tankard by singing near it its "response note," which was in this instance the bass note D flat, which is not far from the lowest audible form of musical energy.

Now if in some of its lowest appreciable forms energy thus sympathetically evolved will break a glass tankard, or "fiddle a bridge down," what must be the force which might be sympathetically awakened in its higher rates of velocity?

Professor Tyndall says—"With a few vibrations a second sound is generated. When more numerous, you may have light, heat and electricity. Again multiplying these by the square of millions, who can say what might, or might not, be the result?" Now we are compelled to believe that every step of acceleration from sixteen vibrations a second to the velocities attained when "multiplied by the square of millions" (as Professor Tyndall says), that every step of this steeply ascending increase is capable of being acted upon sympathetically, *if* the response note could be found.

Is there any limit to the energies thus slumbering in the apparent void? Whether Mr. Keely has captured them or not, these streams of potential energy are a reality, and might be liberated by just the means he is using.

But of one thing there can be no slightest doubt. *As man has risen to higher stages of development he has appropriated progressively higher stages of energy.* There was a period when stored sunshine (light) was sufficient for his material uses. Then heat was harnessed and drove his engines, his wheels and spindles. Then he reached higher and captured electricity, which was found to be no less obedient and vastly more effective. Who dare say this is the end? It was after drawing upon the resources of the *invisible*, that such enormous impulse came into the life of humanity; and the farther we have gone into that supersensible creation, the swifter has been the advance!

It will be seen that as we pass through these ascending grades of energy, its manifestations become more subtle. Increase of power means a corresponding increase of subtlety. The waves of light and heat must be like the heavy beatings of the surf, and the motions of electricity gross and sluggish, compared with the rhythm of those ethereal vibrations which could only be wielded by Omnipotence! And is it not obvious that the agent which sympathetically reaches these, must become correspondingly fine? Is *thought* such an agent?

If a single tone of the human voice be the initial stage of an energy so inconceivable, what, on the other hand, does that voice become when attenuated "by the square of millions?" Does this measure the distance between an audible human cry and the thought which produces it? Is "the heart's sincere desire," the note attuned to those energies whose subtlety, as well as velocity, has been "multiplied by the square of millions?"

The mind cannot go back or stop on such a journey. It is compelled to go on and on until it reaches something with sufficient potency to tear the stars from their orbits, and yet so attenuated that it trembles responsively to something as light as thought. If this be not "spiritual energy," it bears a strange resemblance to it!

Have we by inevitable steps reached the verge of that kingdom we have been accustomed to regard as separate and distinct? If so, matter is lifted from its long abasement. The

pulsations in the heart of granite are the throbbings of the Divine, as truly as when it makes the soul of man tremble with new life. And what wonder that music thrills, if it be a manifestation different in degree, but identical in kind, with the spiritual energy which nourishes the universe?

If the phenomena of matter and of spirit are controlled by the same force, only in different degrees of development, then reasonable cause and effect take the place of magic and of mystery.

If it be true that spiritual atoms, no less than material ones, are arranging themselves according to their velocities, then every relation, human and divine, is comprehensible. If this law underlies both worlds, then those spiritual atoms numerically and rhythmically allied have an "affinity" for each other; they rush together in irresistible embrace; and there is a scientific basis for human affections, for conduct, and for *prayer!*

Race affinities exist because of a general rhythmic identity. Individual temperament is determined by the rate at which the spiritual atoms of the man move—making, as it were, a musical-key to which his being is set. Observe that when you sing a C note over the piano, not alone the C strings, but E, G and B vibrate responsively, because harmoniously related. So two beings who love each other may make a richer harmony for not having identically the same rhythm in their souls. But on the other hand, union with one outside this harmonious group is impossible. Discord is a violation of nature. Two notes inharmoniously related can never combine. They may be simultaneously sounded; but they do not blend. Discord is in its essence a destructive force. Unhappy marriages, in fact one-half the tragedies of human life, find their solution in the laws which govern music; and the language of metaphor is profoundly and scientifically true.

The unfolding soul invites to itself vibrations constructive and destructive, and grows by what it feeds upon toward heaven or hell; harmonious vibrations making for the one, and discordant ones for the other. If, as is probable, these veloci

ties have a tendency to be accelerated in multiples of the same rate, we can see how the wretched being is sometimes lost in the vortex of a terrible rhythm, only to be rescued by that one flawless rhythm left by Christ upon earth.

Does this sound fantastic? Will it be worse than fantastic, prosaic, to say that every human impulse is in its last analysis a mathematical fact? That love, hate and all their diverse manifestations might be expressed by mathematical formula? A mathematical basis for spiritual phenomena sounds uninteresting. But to the soul that comprehends it, it is sublime. Mathematical conceptions are the only ones which do not vanish in the analysis of an illusive, elusive, creation. The multiplication table would survive the wreck of worlds and of matter!

The magnitudes of time and space—what are they? Nothing but modes of thought depending upon a point of view. They exist only relatively to your perception. The "solidity" of matter is a fiction. Were you created on a different scale you might gaze through the intermolecular spaces of granite, and see its whirling atoms as constellations in your heaven of ether!

We look out upon the world through a refracting, twisting, distorting medium, so that nothing is what it seems, and were it not for *mathematical relations*, we should be in a universe of dissolving dreams. But they are everlastingly true. They are the rock-ribbed realities which hold together the shifting, vanishing phenomena of existence. Change your point of view as you may, they are undisturbed.

A truth which has for its mission the upholding of all other truths, has need to be well buttressed and strengthened; and the rocks which bear the Andes on their bosom are not more immovable than the mathematics upon which rests the law of sympathetic vibration.

If there be such scientific basis for human phenomena, then metaphysics and psychology, with their intricacies and complexities expressed in an involved terminology, are artificially contrived systems, and what wonder that they are bewildering, and the despair of ordinary minds?

The human mind is perfectly capable of mastering an artificial system expressed through arbitrary symbols. It has been doing it for ages. (Alas!) But with what result? A few of the initiated know the system, and its terminologies; but neither they, nor any one else, has a vital grip upon the subject. But *can* a subject be made comprehensible, when its most essential truth is veiled? And what wonder there is confusion existing in men's minds regarding the most vital things? The following definitions of Religion are quoted in Kidd's "Social Evolution." We select them at random. Comte, "The worship of humanity." Hegel, "The knowledge acquired by the finite spirit of its essence as an absolute spirit." Huxley, "Reverence and love for the ethical ideal." Matthew Arnold, "Morality touched by emotion."

These definitions are by men who are masters of thought and of expression, and offer, presumably, the best the world has to say on the subject. Are they convincing?—satisfying? Would any one know that any two of them were intended to define the same thing?

Hear now the definition of religion if sympathetic vibration be a fundamental law. Religion is an expression of a *universal impulse, which draws the human heart into rythmic unity with the Divine heart.*

How simple—how true. It is the unconscious utterance of the unlettered in all ages; and of poets, from King David to Tennyson; and at the same time a precise scientific statement, which is—to Ommiscience at least—capable of mathematical demonstration.

But how can there be a satisfying definition if the fact underlying all other facts be not considered?—*i.e.*, that there are precise definite atomic changes in spiritual experiences no less *real*, for having vanished into a region infinitely subtle, than if transposed to the lower key of sound, heat and light, or to the still lower condition of the visible and ponderable.

Men have discovered a great progressive movement in all organic things which they have called "Evolution." We see it as an imposing mysterious thing moving with awful

sincerity on grand lines. But if the source of energy lies in the atom, its beginnings are infinitely small. It is the aggregate of a minute atomic *hunger for unity with the Divine.* That is the sublime consummation toward which all creation moves; and *evolution* is a religious impulse! Nature is thinking of the atom—not the mass. All earthly systems which sacrifice the atom are foredoomed, because the great mother knows no great and no small, but only a stern necessity for an adaptation, precise and true, to the Eternal rhythm, which, in the evolutionary process, means an infinite progression, while its absence means disintegration and elimination.

Science might have looked forever in vain through the telescope. Not till it turned its vision in toward the invisible—the supersensible—did any true comprehension come of creaitve and cosmic realities. And the deeper it penetrates into this region, the stronger does it feel the throbbing of the Divine heart. Its own path is leading it, whether it will or no, where it must some day find itself face to face with Deity.

Two lines started in certain directions from given points in the earth's orbit, must meet at a certain point millions of miles away. You have never been there to see it. But you know it. It is a necessity of thought to believe it. And so, certain truths compel the existence of certain other truths. The mind cannot escape them.

Just such compelling power is in the law of sympathetic vibration. Once started on its ascending ladder, it is impossible to stop, until we find ourselves confronted with energies inconceivably great and inconceivably fine. Surely it is not venturesome to leap the little chasm of uncertainly and call these "spiritual energies," nor to believe that they by their sympathetic action may be the basis of all the phenomena of the life of the soul.

There is something new and strange in the air. A new element in the spiritual as well as the material atmosphere. Men are vaguely conscious of an impending crisis in the life of humanity. Is this because we have reached the confines of the old, and are entering upon a new dispensation of force,

one which will enter into the processes of life in a manner more vital even than electricity has done?

However this may be, if the trend of progress is to be in the future the same as it has been in the past, it is man's inevitable destiny to grasp and appropriate higher and higher conditions of an energy which at each remove becomes more spiritualized in its expression. Whether this in fact merges at last into the "spiritual energy" which is the life of the soul, is a question this article is intended to ask—not to answer.

THE CONTINUITY OF LIFE.

By "Ormond."

The oldest person living cannot remember the time when leading thinkers of the world were not speculating on the probable future for man. It might, perhaps, be still more proper to say, that since the first appearance of man on the earth the leading thought of his life has been the uncertainty as to his future state or condition. Even to-day, with the pulsating vigor of a progressive civilization on every hand, there is no really settled belief in the minds of the great mass of the human family on this question.

What is the reason for this absence of belief in a great fact which is by inheritance the birthright of every person now living or who ever lived?

The philosophers of old, in attempting to account for man's first appearance, were finally compelled to adopt the belief that he must have descended from the gods, because they found that he was possessed of both a material and a mental or spiritual nature, and therefore must have had a spiritual origin. The thought of a great army of gods was nesessarily abandoned, because it was soon discovered that such a mighty, matchless and wonderful world as this is, must have been designed and created by one supreme power or intelligence, and that it would be unreasonable to suppose that the Creator of the material world was not also the Creator of man. Such a statement should not be made in a

paper of this kind without defining the term "Creation" as meaning the forming of what exists from what previously existed; in other words, it is not my belief that this world (with its countless millions of representatives of animate and inanimate life) was made out of nothing.

Creation is a fact; but the great difficulty in the way of good thinkers has been to give such an explanation of this term as would prove satisfactory to the people. The mode or process of creation is not known, and in the nature of the case never can be; but it is plain that the definition given by some commentators of this term, "the making of something out of nothing," is illogical, unreasonable and untrue; therefore, such a thought should be replaced with a better one. It would be impossible for the human mind to adopt the thought of creation, if it were not for the fact that science demonstrates the impossibility of this earth having supported the life of man but, comparatively speaking, a few thousand years, while the earth itself has undoubtedly existed many millions of years. Back of any formulated globe or planet, on which man now has an abiding place, the probability is that the elements of nature were in a chaotic mass, and it is reasonable to suppose that creation consisted in bringing these elements together in such relation as to form a world and everything that exists of a material nature.

It should be admitted by all good students that the elements of nature have always existed; hence there has always been something out of which to form whatever exists that is of the same nature as these elements.

It will be as well to leave this thought for later consideration, and direct our attention to some collateral facts in the organization of man that do not appear in any other created being or thing; otherwise we should be unable to account for him, though we might accept the above or some similar theory as to the general creation.

Man, as has been stated, is a being having two natures, or, as commonly stated, is a dual creature, and it would, therefore, be impossible to account for anything but his

material body as having been formed out of the elements of nature, which are also material.

It is, of course, true, that the operations of the law of evolution, or progression, have resulted in the present comparative perfection of everything that exists, including man; but everything that exists must have originally possessed all the inherent powers and faculties it now has, and this is equivalent to saying that the law of evolution never did, nor can, add a single faculty to the organization of man. Perhaps it will not be considered modest by a certain class of thinkers that such an emphatic statement should be made, but it is absolutely necessary that the thought of the Middle Ages, modified and changed as it has been from time to time, regarding the function and power of the very simple law of evolution, should be abandoned.

Law is an enactment of God or man and has no power in itself; therefore, the law of evolution is simply a mode or process by which everything reaches the perfection of its inherent life. In other words, the law of evolution could not act, unless it had something to act upon, and in the case of man this something was the man in embryo as he came from the Creator. It would be impossible to say in just what form the original man was created, but if our reasoning is correct man has always been man, rather than at some time in his existence a fish, fowl, or monkey. The mistake of supposing that any scientist has or can demonstrate the evolution of any *distinct* species from any other known species, has resulted in more dissatisfaction as to our condition in this world, and prospects of a brighter and better condition in the future, than any other theory that has met with the least degree of favor by good thinkers.

If the eminent naturalist, Mr. Charles Darwin, could by any possibility return from his present home or condition, he would undoubtedly caution his admirers not to believe anything more regarding the "Evolution of the Species" than he was able to demonstrate in a life-time of patient study, and that was, a distinct difference, as well as similarity, in many species.

XUM

It was not the intention to include in this article any discussion of this question, but it seems necessary to take issue with the thought that evolution has ever resulted in the change of any species of life, and to assert that the law of evolution, like the laws of gravitation, repulsion and attraction, are simply laws in the control of the Creator, and used for the purposes for which they were designed or enacted; therefore, the credit for what has been accomplished belongs to the intelligence back of these laws, rather than to the laws which have no intelligence within themselves.

Let us, if you please, pass this thought now, and barely mention a few things that should be believed without any argument.

The life of man is continuous from his birth until his physical death, that is to say, during his three-score years and ten, or as long as he continues to breathe he is alive.

The problem which we have undertaken to solve is the bridging of this fearful chasm of death, and, by the eye of faith, reason, and logic, follow the human family into a condition of life which is simply a continuation of their present life, freed only from their physical bodies. Can it be done?

In order that every person may feel at perfect liberty to take issue with me on the mooted questions here discussed, I desire frankly to admit that I am but a modest layman, and do not pretend to speak with authority, but my convictions are as here stated, and, if unreasonable, they will not and should not be accepted.

The mind of man is the real man, and it would seem, therefore, that no argument would be necessary to prove the continuous life of every person, because it would be impossible to think of anything having the nature of mind passing through the chamber of death; that is to say, the change that comes to every one at death is simply the laying off of, and departing from, the physical body.

This thought may, perhaps, be stated differently, and be more satisfactory to some readers. If the corporeal body was in a true sense the real man or person, there would be no occasion for postulating any opinion as to future condi-

tion, because the evidences of the material man's returning to the elements through the process of disintegration and decay are observable every day.

When we consider man as a dual creature, we are compelled to recognize this fact, that the mental or spiritual nature is not subject to death, but must continue to exist and perform its life and function of thought precisely as before the loss of the material body.

This thought must be elaborated a little, because, strange as it may appear, some people have an idea that mind is simply a manifestation of matter, when the real fact is that organized matter is a manifestation of mind, as I have tried to show in the few thoughts about creation. Professors of Theology would not claim that this science could demonstrate any fact in connection with the future condition of man, because science can only deal with material substances, and the mind, or future man, is spiritual. It must be true that every person has a spiritual body as well as a natural or material body, otherwise there would be no recognition of friends in the next world, but this spiritual body is of the same nature as of the mind, and therefore is not affected by the death of the material body.

Having digressed sufficiently to mention a few facts that seem necessary for a proper understanding of what follows, we will now proceed with the argument, and give a reason for our faith in the continuous conscious existence of every person.

When we consider the nature of man, we are compelled to believe that while his physical body is the work of creation (without attempting to define the way or process), we are equally sure that the mind or real man is a gift from God and not a creation.

It may be well to digress again for a moment at this point, and explain fully the meaning of our last paragraph.

When this world was created we do not know, but in due time it was fitted for the habitation of man, and the only account we have of his appearing is found in the first book of our Bibles. This account is not as precise and elaborate

as we wish it was, but we learn that "God made man out of the dust of the earth," which statement is equivalent to saying that *man was made out of the elements of nature*, because the earth contains all of these elements.

After the physical man was created, the account goes on to say that "God breathed into his nostrils the breath of life." My thought is, that this "breath of life" was the mind which God gave to man, and which relates him to the spiritual world.

Words at our command are sometimes inadequate to express our real belief, and this is frequently the case when considering a metaphysical subject which in itself covers so much ground, but which must be stated in comparatively few sentences, in a paper prepared for a work of this kind.

To my thought there is no difficulty in constructing an absolutely flawless bridge between the material and spiritual conditions of life, because, as a matter of fact, it is purely a mental conception of what already exists in the very nature of man. Mind is not a manifestation of matter, but is the part of man said to be in the "Image of God," which is equivalent to saying, that, as God is spirit, so man is a spirit—not that man is in any sense equal with God, but is of the same nature. The early philosophers caught this idea, and proclaimed the divinity of all men, but the better thought is that we are all children of God, and destined to a life and condition after the death of our material body that will favor our march of progression through the endless ages of Eternity.

SCIENTIFIC IRRITABILITY.

By Evelyn J. Hardy.

Poets have long been known as an irritable race, musicians and artists are often jealous of their brethren and impatient of criticism, while the proverbial animosities of men of letters are rather suspended than abolished by combinations for purposes of log-rolling. Men of science, however, have been accustomed to claim exemption from professional envy and uncharitableness. Engaged in the search for truth and brought into continual contact with reality, they claim and are usually supposed to possess a serener temper and a larger outlook than more emotional beings can hope to enjoy. It is, therefore, not a little remarkable to find that the scientific world of Great Britain is at present agitated by a controversy of peculiar bitterness, carried on with the aid of personalities from which an excitable poet might shrink. We might call it the Argon controversy, because the advent of that mysterious substance seems to have accentuated previously existing disputes while creating new and peculiarly acute disagreements of its own. But though the whole imbroglio can be conveniently treated from the Argon point of view, it must not be forgotten for a moment that long before Argon was heard of there was profound uneasiness in chemical and physical circles, and indeed more or less through the entire range of British science.

To begin with, the Royal Society has for two years past been in a very uncomfortable and irritable condition. It is a very dignified and respectable body, but like other such bodies it has gradually acquired the habit of thinking itself beyond criticism; although, as a matter of fact, it has become to a great extent fossilized, and is gradually but surely losing the position it ought to occupy. *The Times* criticized, no doubt, with some sharpness, but in the most friendly spirit, the faults of management and organization which are thus sapping its authority. But instead of taking the criticisms in

good part and profiting by them, the officials of the Royal Society, together with "the following," which officials can always command, became extremely indignant. Like other angry people in similar circumstances they made up their minds that an enemy had done this thing, and going behind *The Times* they saw fit to fasten the responsibility upon Professor Dewar. So far did they carry this unjustifiable identification that when a particularly annoying revelation was made concerning the non-payment for several years of money which ought to accompany the Rumford Medal, the Treasurer of the Royal Society had the imprudence openly to charge Professor Dewar in public meeting with the authorship of the criticism. He had scarcely made the charge when he was compelled to withdraw it, but the ridiculous position in which he thus placed himself and the Royal Society naturally did not tend to soothe angry feelings.

A law suit turning upon the legal construction of a patent might seem at first sight to be a thing which men of science might contrive to view without undue excitement, yet this also has played a considerable part in setting them by the ears. The British Government manufactures cordite for military and naval purposes, under a process patented on its behalf by Sir Frederick Abel and Professor Dewar. The Nobel Dynamite Company brought an action to have it declared that this process is an infringement of their patents. Judgment went against them and they appealed. The Court of Appeal confirmed the judgment, and they then carried the matter to the House of Lords, which unanimously upheld the conclusions arrived at by the Courts below. But, while the original trial was pending, every effort was made to obscure the legal questions at issue by the most reckless attacks upon the personal character of the two chemists who worked out the Government process. Day after day they were loaded with vituperation in the press; although they did not stand to lose or gain a cent, and were fighting the battle of the taxpayer. It is, of course, impossible to identify the professional sources of such technical knowledge as these attacks required, but there is no doubt whatever that

means were found to enlist the sympathy of a large number of professional men upon the side of the company which sought to extract from half a million to a million sterling from the treasury. To all these people, their partisans and their satellites, the total failure of the enterprise with which they identified themselves is, of course, a bitter disappointment. They are, consequently, eager upon every occasion to make common cause with the furious wire-pullers of the Royal Society in wreaking their vengeance upon the men to whom both sets rightly or wrongly ascribe their discomfiture.

It was while all these angry passions were seething in the breasts of men of science that Lord Rayleigh announced, at the meeting of the British Association, the discovery of a gas in the atmosphere which had until then escaped observation. Next to nothing was told about it, for the excellent reason, as afterward appeared, that next to nothing was known. The gas had been procured in very small quantities and by methods which certainly did not exclude the possibility that it was a manufactured product. It was stated to exist in the atmosphere to the amount of one per cent. and a relatively high density was assigned to it. Accepting these *data*, Professor Dewar pointed out in letters to *The Times* that the new gas ought to have been noticeable and even conspicuous in the experiments he had carried on at low temperatures, in which large quantities of air, to the extent of five hundred grammes, were liquified. This reference to a difficulty which exists and cannot be shirked, was not received quite in the scientific spirit. Indeed, it is not too much to say that it was resented as a personal affront, although it was not explicitly put forward in that light until a later period. As the year drew to its close it became evident that the discoverers of the new gas were at the same time unwilling to make known the results of their further researches, and very much disposed to resent inquiry. The announcement to the British Association, though followed up by a very explicit affirmation of the importance of the discovery at the anniversary meeting of the Royal Society

on November 30th, was declared not to be publication in the sense of throwing open the subject to scientific discussion. Nevertheless, it was apparently held to be publication in the sense of stopping others from trespassing upon the domain of Lord Rayleigh and Professor Ramsay. Chemists naturally found some difficulty in understanding the position assumed by the discoverers, though it was not wholly unintelligible from a business point of view. The Smithsonian Institution had offered a prize of ten thousand dollars for any discovery of value or novelty connected with the atmosphere, and the competitors for that sum were required to lodge their papers by the end of December. It was evidently feared that technical publication before that date might endanger the success of the application for the prize; and it was only after the Secretary of the Smithsonian Institution had publicly announced in January the removal of all restriction upon publication, that the discoverers of the new gas condescended to take British chemists into their confidence. This conduct would, of course, have been quite intelligible if they had not at the same time shown themselves so anxious to secure the incompatible advantages of a claim to priority over other possible discoverers by means of publication to the British Association.

In the meantime they had been busy supplementing the very scanty information concerning the new element which was at their disposal when they made their first announcement. As they could not find that it possesses any chemical activity whatever, there was nothing to be done but to fall back upon its physical properties. In the investigation of these properties low temperatures become highly important, and as Lord Rayleigh is a professor at the Royal Institution it would have seemed natural to carry out the required experiments by the aid of its powerful apparatus. Its resources were, of course, entirely at Lord Rayleigh's disposal, and he was, indeed, pressed to use them. But he had handed over the low temperature work to the exclusive care of his colleague, Professor Ramsay, who could scarcely expect the professor of chemistry at the Royal Institution

to vacate the laboratory for his benefit. Seeing that they could not use the Royal Institution exactly as they desired, the joint discoverers of the new gas decided to hand over the whole determination of its physical constants to Professor Olszewski, of Cracow, by whom, as a matter of fact, every bit of accurate information concerning its physical properties seems to have been obtained. It has been spectroscopically investigated by Mr. Crookes, and when we deduct his and Professor Olszewski's determinations it is difficult to find anything remaining to the credit of the discoverers, except the bare announcement that the new gas exists.

When at length all was ready for the momentous and long delayed publication, advantage was taken of a new departure on the part of the Royal Society to invest the proceedings with unwonted *eclat*. Whether as a result of the criticisms already referred to, or of the too palpable advance of other scientific bodies to a position of equality and independence, the Royal Society has resorted to public discussions upon single papers instead of adhering to the old routine. The first discussion of this kind was devoted to Argon, and everything was done to secure a popular success. The public were freely admitted, probably for the first time since the Royal Society was founded, without any formality whatever; and a compact body of students, installed in a commanding position in the center of the hall, cheered at appropriate moments with the precision and vigor of a practiced theatrical *claque*. Nevertheless, it could hardly be affirmed by the most partial observer that the Royal Society's first discussion was a great success. Indeed, what discussion there was found its place in the paper read by Professor Ramsay, rather than in the subsequent conversation, which consisted merely of complimentary and uncritical observations. The discoverers, even with the help of the Polish professor, seemed very much at a loss to classify their new gas. They had arguments to show that it is monatomic, and other arguments to prove the contrary. They canvassed the question whether it is simple or compound, in the sense of

being a mixture of simple substances. They tried it in different positions in Mendeleeff's scheme of the elements, and did not quite like the look of it in any of them. In short, they discussed so many *pros* and *cons*, and were so far from taking up a definite and intelligible position of any kind, that they offered nothing for other people to discuss. There were almost pathetic appeals for somebody to say something, or even to ask a question, but nobody responded, and when the compliments were all paid the discussion fizzled out. The situation was not, however, quite without its consolations. Professor Ramsay had the pleasure of taking a fling at the Fullerian professor at the Royal Institution, by referring to Professor Olszewski as "*the* authority on low temperatures," and making a significant pause at the end of the phrase, which was punctually filled up by the *claque*. The manœuvre was very nicely planned and was perfectly successful. We may hope that it brought balm to souls tortured by the poison of professional jealousy. But it is another question whether the Royal Society will either retrieve the blunders repeatedly made by its official apologists, or improve its position in the world of science, by thus stooping to the artifices of the political platform. It must, of course, be admitted that it was annoying for the discoverers to find themselves, after many months, in the exact position described by Professor Dewar in the letter to *The Times*, which so unaccountably stirred their bile on its appearance. It was in August that he pointed out the anomalous character of a substance presumed to be present in air to the extent of from half to one per cent., and having a density nearly one and a half times as great as that of nitrogen; yet failing to reveal its presence when such quantities as five hundred grammes of air are liquefied, either by separating in the solid form or by remaining behind when the far more volatile oxygen and nitrogen are distilled off. It was in January, and after consulting "*the* authority on low temperatures," that Professor Ramsay had to indulge in all sorts of ingenious speculations in order to conceal the fact that light had been thrown upon the problem, and

nothing had been done to explain peculiarities without parallel in chemical experience. But provoking as it was for Professor Ramsay to find himself just where his critic had placed him five good months before, he ought to have controlled his feelings by reflecting that after all it was not Professor Dewar, but the stubborn facts of the case with which he had to deal. Scientific training does a man very little good if it does not teach him to meet troubles of this kind with patience and good humor.

Professor Olszewski's English friends made a very poor return for the eminent services he rendered them, when they encouraged him to mix himself up with their private animosities, and used him as cover in a new and unusually rancorous attack. In *Nature*, of January 10th, appeared a letter from him complaining in a somewhat querulous tone that although at one time Professor Dewar had been accustomed to mention his name in connection with low temperature experiments, yet that more recently he had by omitting that formality fostered an erroneous conception of the value and originality of his own work. Now the grievances to which the Polish professor more particularly referred were four or five years old. It is incredible that a gentleman so thin-skinned as his letter showed him to be, should have allowed a claim for priority to lie dormant for such a length of time, and it is at least a curious coincidence that his sudden awakening to the iniquity of the treatment accorded to him should have so exactly coincided with his entry into close relations with the leading spirits of the Argon controversy. When his letter appeared it was the opinion of good judges that the intimation did not come from Professor Olszewski, but from people nearer home, who saw their way to make him a cat's-paw. Nor was it long before ample confirmation of this opinion presented itself. A short but adequate reply to the novel claim for priority appeared along with it in *Nature*, merely referring to the notorious fact that the honor of first liquefying the permanent gases had long been officially and universally recognized as belonging to neither Professor Olszewski nor

to Professor Dewar, and adding references to the proceedings of the Royal Institution which completely disposed of the insinuation that the English investigator had borrowed his ideas and his apparatus from Cracow.

There, as far as Professor Olszewski is concerned, the matter came to an end. But five weeks later, on February 14th, a letter appeared in *Nature*, signed by Mr. Pattison Muir, who labored through three columns to convert the original dispute about priority into a charge of deliberate fraud against Professor Dewar. This Mr. Pattison Muir, it may be well to observe, is a college lecturer on chemistry at Cambridge, and a fairly industrious compiler of chemical text-books. His most conspicuous peculiarity is complete inability to understand why he, with these admirable tutorial qualifications, has never been assigned a place among original workers in chemistry and physics. The difficulty has not presented itself to other minds, nor are his pretensions received with anything but a tolerant smile even in the circles most appreciative of his merits. But he has never reconciled himself to the verdict of the scientific world, and in particular has chafed for many years under the invidious distinction which an unjust public insists upon making between himself and Professor Dewar. There is some reason to fear that he has not yet succeeded in making the distinction less broad or less obvious. His three columns of splenetic depreciation had no relevancy whatever to the peculiarly offensive charge which he saw fit to engraft upon Professor Olszewski's claim to priority; and the vigorous reply from Professor Dewar showed him to be reckless in his treatment, and not too scrupulous in his choice of the facts upon which he relied to prove his slander. Mr. Pattison Muir saw fit to drop the line of attack followed in his first letter, and in *Nature* of February 21st fell back upon the vulgar dialectical trick of a rejoinder to his opponent's reply in which the essential questions were elaborately shirked. Extracting four "claims" from Professor Dewar's reply he failed to upset a single one, though he made their discussion the occasion for venting the animosity which has

just been explained. His second letter like his first wound up with a Pecksniffian expression of concern for the good name of the scientific men of the country, and a demand, extremely amusing as coming from Mr. Pattison Muir, for "instant and serious consideration" of the skimble-skamble stuff which to his jaundiced vision appears good enough to support a charge of wilful dishonesty. A week later he was made to look, if possible, more foolish than before by Professor Dewar's reply, which forced him to take shelter in the trick of trying to shuffle the *onus probandi* upon the man he wantonly assailed. In other words, having undertaken to prove Professor Dewar a rogue and having failed, this spiteful little pedagogue turns round and complains that the object of his abuse has not proved himself to Mr. Muir's satisfaction an honest man. How far this gentleman represents others, and how far he is merely seizing an opportunity to pour forth his long-digested venom, is a question not easy to answer. But in any case his letters form a fitting climax to the manifestations of jealousy and ill temper which for some time past have disfigured the annals of British science.

This interesting study of scientific irritability cannot be carried any further at present. But the history so far would be incomplete without a reference to the unpleasant fact that even the impartiality of scientific journalism seems to be imperilled by the angry passions of men of science. The editor of *Nature* set at defiance all accepted rules of journalistic courtesy and fair play by excising portions of Professor Dewar's first reply, marking the omissions with a line of dots, and adding a foot-note to say that they consisted of personalities. Considering that Mr. Pattison Muir's attack was one gigantic personality of the grossest and most offensive kind, this tender regard for the proprieties is at least as singular as the mode of showing it is unprecedented. Professor Dewar's second letter was mutilated by the excision of passages which could in no sense be described as personalities, though they were probably too incisive to suit the taste of the other party to the controversy. Mr. Pattison Muir is known to have been for many years a contributor to

Nature, and his studiously offensive letter, dealing with a quarrel which was none of his, was so far beyond the lines usually observed by editorial discretion as to suggest that several points were strained in his favor when it was inserted. What has subsequently occurred would almost justify the suspicion that he was allowed to edit his opponent's replies in a controversy of his own raising. The matter is not of much consequence, because there fortunately exist in England great lay journals conducted with an abiding love of fair play. Such occurrences only serve to strengthen the disposition of scientific workers to appeal through such journals to a larger public and a more equitable tribunal than can always be found within scientific confines.

THE UNITY OF MATTER.

Vast as are the domains which science seeks to conquer, marvelous as her work has been during the present century, she cannot reach even the borders of the infinite realms that lie beyond her present domains until she has penetrated the mysteries which surround the path she has chosen, and, in doing so, discovers that the problems which she has pronounced to be unsolvable are within her reach, provided she takes the high road of knowledge that leads to their solution.

The history of all scientific progress shows us that the paths of learning are not always those of knowledge. Again and again, what has been considered as an immovable foundation of well-arranged facts, on which the edifice of philosophy was to be built, has had to be destroyed in order to replace it with a better foundation. Only yesterday was it announced by two Englishmen of science, Lord Rayleigh and Professor Ramsay, that atmospheric air, which was supposed to be composed of two gases only (as we have blindly believed for a century on the word of Lavoisier) has a third gas, which they, as its discoverers, have named "argon," but which is, however, of too inert a character to create any alarm to those who breathe it.

XUM

Mr. Strindberg, a Swede, now announces that he has discovered sulphur to be a compound instead of a simple body, as hitherto regarded.

The physical and chemical properties of sulphur are of exceptional peculiarity. Solid under ordinary temperature, it melts at 115° and boils at 440°. Insoluble in water, it dissolves in alcohol, benzine, sulphuret of carbon, and in essential oils. A bad conductor of heat and electricity, it presents itself under apparently contradictory conditions. Thus it is at times *amorphous*, and at times crystallized, either in prisms or in *octahèdra ;* its density varying with the form it takes. If melted at 115° it is fluid and transparent; but at a higher temperature it becomes black and viscous. If thrown suddenly into water it then takes a soft and elastic consistency, like India-rubber. At 200°, when in contact with air, it becomes phosphorescent; at 250° it ignites and burns with its characteristic blue flame, throwing off sulphurous acid, and acting as oxygen does in the presence of certain metals, such as iron filings, with which it is capable of uniting even when cold. In short, it is a sort of Proteus, as hard to discipline as it is to define.

There is no doubt that in past times many a French *savant* suspected this capricious being of deception in passing itself off for a simple body, but their suspicions were only presentments; or, at most, a mere unsubstantiated hypothesis. It was left for Strindberg, known as a man of literature, to search for experimental proof of the truth of their conjectures. He now announces that he has dissociated sulphur, and that it is a resinous product of oxygen, hydrogen and carbon.[1]

Poets sometimes have inspirations, or genial illuminations, which seem out of harmony with their special acquirements; but which, if pursued, may as well lead to progress

[1] On this subject Professor Crookes says:

"I am quite prepared to hear that sulphur, like many other of our chemical elements, is really a compound body, but it will not turn out to be a mixture of oxygen, hydrogen and carbon. Neither will its compound character be proved by such very elementary experiments as are described."

in the arts as the researches of men who are not of idealistic temperament. It was such illuminations that led Charles Cros, of Languedoc, to invent the precursor of the phonograph, and to forecast the photophone and the radiometer, and to make known, long before Iremy and Moissau, the artificial synthesis of precious stones.

Strindberg, also an idealist, with the same instructive intuition, refused to recognize the fallacious simplicity of sulphur and vowed to himself that he would not rest until he had proved it to be a compound. In melting sulphur at 120°, he found it giving out a strong smell of camphor; it lost so much of its oxygen that it appeared to be changed into camphor. At 160° to 200° it took the color and consistency of India-rubber, having lost still more of its oxygen and of its hydrogen. Heated in contact with linseed oil, the latter was transformed into a resinous glue. Boiled with essence of cloves it formed crystals of camphor, in needle-like formations.

The destiny of amorphous sulphur is 1.97, while that of ordinary sulphur is 2.07. What can explain this anomaly but the fact that the amorphous sulphur, the return of which to its crystalline state is attended with dispersion of heat, is deprived of its oxygen and thereby diminished in weight? That oxygen is one of its constituents is also proved by the resinous glue into which linseed oil is transformed when the two are heated together. But if sulphur is a resinous substance it must also contain carbon; and that carbon is one of its constituents, Mr. Strindberg thinks he has proved beyond doubt. After burning amorphous sulphur in a crucible he obtained as its residue a black powder; which, in combustion, yields oxide of carbon and carbonic acid.

With the fine audacity of faith, Mr. Strindberg is now preparing for a series of experiments, to be made before distinguished Parisian chemists, including Mr. Berthelot, under the most rigorous conditions of exactitude. If he succeeds in despoiling sulphur of the individuality it has usurped, the announcement will be made that it has been relegated to the ranks of the "ternary radicles." It will then be the turn of

phosphorus—whose ways are no less whimsical and suspicious—to contribute her testimony to the unity of matter, which amounts to saying that the so-called simple substances are, in reality, only different conditions of one fundamental element, the woof and stratum of all that is:—protyl, according to Crookes; hydrogen, according to Norman Lockyer; carbon, according to Hæckel; and the luminiferous ether according to Keely. On that day the seekers after the philosopher's stone and the transmutation of metals, says Emile Gautier (in closing his paper on Strindberg's discovery), will have made a great step in advance.

NOTES ON THE PROGRESS OF SCIENCE.

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Academy of Natural Sciences of Philadelphia.

THE AGE OF THE EARTH.

To those who have fondly held to the notion that the doctrine of evolution was disproved, or at least rendered doubtful by a mathematical demonstration of the comparative newness of our planet, and the inefficiency of its life-period to bring about that wonderful divergence of plant and animal forms which we everywhere see about us, the redetermination of the age of the earth by Prof. Perry, with the aid of the formulæ used by Sir William Thomson (Lord Kelvin), will come as a rude shock. It is now upward of a quarter of a century since Sir William Thomson published the results of his calculations, based upon the study of loss of heat of the planet, tending to show that the period of solidification of the earth could not have been less than twenty million years ago, nor more than four hundred million years, and in general it was assumed that one hundred million years most nearly represented the actual period. This determination has been very generally accepted on the part of physicists, and has even crept into many of the standard works of geology,

despite the feeling on the part of most geologists that the facts in their possession, derived from a study of the slow processes of denudation and sedimentation, argued strongly against this short period. Prof. Perry, who is himself a pupil of Lord Kelvin, now comes to the assistance of the geologist by asserting that if we assume a higher conductivity of the rocks of the interior of the earth than for those of the surface, which is rendered extremely probable through the conditions of high temperatures which there prevail, the time period of cooling can be very materially increased; and, indeed, the rather startling conclusion is reached that "even for a perfectly solid earth an age one thousand three hundred times the age given by Lord Kelvin" is not incompatible with the facts that are now accessible. Lord Kelvin, in a personal letter addressed to Prof. Perry, and bearing date of December 13th, 1894, with a true scientific spirit, admits the force of Prof. Perry's criticism, and states: "I thought my range from twenty millions to four hundred millions was probably wide enough, but it is quite possible that I should have put the superior limit a good deal higher, perhaps four thousand instead of four hundred."

THE MISSING LINK.

It would seem that an animal form intermediate in structure between man and the man-like apes, and properly entitled to the designation of "missing link," has finally been discovered. The find in question is brought to the notice of scientists by Dr. Eugene Dubois, of the Dutch East Indian army, who, in an elaborate memoir, describes the remains of a preëminently hominine anthropoid which were recently obtained from the post-pliocene, or, possibly, even pliocene deposits of the island of Java. These remains consist of the roof of the skull, the femur, and a molar tooth of a mammalian, which was of approximately the size of a man, but whose simian affinities were clearly indicated in the general cranial conformation, and in certain peculiarities of structure of the thigh-bone. Dr. Du-

bois calls special attention to the marked development of the cranial arch, which is represented to be about half-way intermediate between what is found in man and in the chimpanzee, and to the cranial volume, which is double that of the gorilla, and actually approaches the "physiological minimum" in man. The thigh-bone is in form and dimensions the absolute analogue of that of man; and, in the opinion of the author, gives unmistakable evidence of having supported an habitually erect body. If the facts pertaining to this remarkable fossil have been correctly interpreted, and there would appear to be no special reasons for doubting that they have, then they must be considered to mark one of the most important discoveries—and perhaps the most significant—that have hitherto been made in the domain of evolutionary science. It is unfortunate that the remains come in single pieced, and it may be that they are merely a physiological abnormality (which there is no special reason to assume), but such as they are they must be given full weight, and for the moment they add considerably to the significance of the hotly-contested Neanderthal and Spy finds. Dr. Dubois unhesitatingly places the extinct Javan ape or, more properly, "manlike transition form" (*menschenähnliche Uebergangsform*), upon which he imposes the not inappropriate name of *Pithecanthropus erectus*, as the intermediate form between man and the true anthropoid apes, and the order of development (evolution) which he assumes to have been most likely is: *Prothylobates*, *Anthropopithecus Sivalensis*, *Pithecanthropus*, and man. The nearest ally to Pithecanthropus is seemingly a large chimpanzoid (*Anthropopithecus Sivalensis*) from the deposits of the Siwalik Hills of India, which, indeed, may be ancestral to both the newly-discovered form and to the African chimpanzee as well. The region in which the remains were found is one in which a more progressive ape (or ape-like form) than any with which we are now acquainted, might very well have lived, and it would be a little strange if forms somewhat like the gibbon or the orang should not be discovered in the younger deposits of this anthrozoal tract.

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THE RICHNESS OF THE AFRICAN GOLD-FIELDS.

The richness of the African gold-fields, as it is portrayed by Dr. Karl Futterer in his recent publication, "Afrika in seiner Bedeutung für die Goldproduktion in Vergangenheit, Gegenwart and Zukunft," will come as a surprise even to those who have looked most optimistically upon the "dark continent" as the most hopeful source of supply of the standard medium of exchange for the future. At the present time the gold-mining activity is nearly all concentrated in the region of the Transvaal, whence in 1893 there was obtained a product the valuation of which was placed at upward of twenty-nine million dollars, or very nearly a full tenth of the total African yield, counting from the days of the Egyptian kings. According to Diodorus, these early potentates mined gold to the extent of some thirty million dollars. So far as it has been possible to trace the mining operations of the past, it would seem that northeast Africa has yielded gold to an amount of approximately eighty million dollars, northwest Africa one hundred and fifty million dollars, and the equatorial and southern regions sixty million dollars. Dr. Futterer holds firmly to the opinion that for many years yet to come the gold output will be largely on the increase, and he estimates that from the Witwatersrand gold-fields alone the yield in twenty-five years will be not less than one billion dollars. It is conjectured that at the end of this time the mining operations will be conducted at a depth of half a mile, but with the improved methods of shafting, cooling and ventilation, no serious obstacle to operating at even much greater depths need be anticipated.

HIGH ATMOSPHERIC NAVIGATION.

A recent number of the *Journal of Aeronautics* contains an account of the very remarkable voyage of Dr. A. Berson in the balloon ship "Phœnix," which started from the town of Stassfurt, Germany, on the fourth of December last. The balloon was charged with two thousand cubic metres of hydrogen gas, and amply supplied with instru-

ments for registering wind velocities, temperature, and barometric pressures. In a quarter of an hour after the start the balloon had risen to two thousand metres (sixty-five hundred feet), and in an hour to five thousand metres or sixteen thousand feet, the thermometer registering 18° C. below zero (0° F.). In less than two hours the bold aeronaut was carried to twenty-six thousand feet, or to an elevation exceeding all mountain summits, with the exception of the loftiest of the Himalayas. The thermometer at this point marked —39° C. (—38° F.), or very nearly the lowest that had been recorded on any mountain top (the winter temperature of the summit of Mount Ararat, as reported by General Venukof). Neither the rarefied atmosphere nor the cold seems to have materially interfered with the intellectual processes of the aeronaut, who, however, was forced to a close communion with the oxygen bags. When ceasing for a few seconds to breathe from these bags, Dr. Berson felt dizzy and dangerously weak, but only once did his eyes close against himself. In two and a half hours after the start the adventurous scientist reached the highest point of his journey, nine thousand one hundred and fifty metres (thirty thousand and twelve feet), an elevation almost exactly one thousand feet above the summit of Mount Everest. At this prodigious height, where the barometer registered an atmospheric pressure of only two hundred and thirty-one millimetres, or nine and nine one-hundredths inches, careful readings of the instruments were still made, and the condition of the observer was such that seemingly he might have ascended considerably further. The temperature in this greatly attenuated atmosphere was —47.9° C. (—54° F.) For a full hour after the "highest" was reached, two of Dr. Berson's fingers remained frozen, but beyond this comparatively little discomfort was experienced. The descent was made in slow calculated curves, with final arrival on a stubble-field at Schœnwohld, near Kiel. Among the interesting results of this atmospheric exploration were the determination of humidity in the highest zones, the snow-flake struc-

ture of cirrus clouds, a tremendous increase of wind-velocity with the ascent, and the great lowering of winter temperatures between five thousand and thirty thousand feet.

THE GREAT IRON-STONE OF NORTHERN GREENLAND.

One of the results of the past year's exploration of Greenland by Lieut. Peary has been the location of the famous iron-stones or "iron mountains" of Cape York, to which Sir John Ross first directed attention in the early part of the century. They were known, through the accounts of the natives, to furnish the Eskimos of that region, the so-called "Arctic Highlanders," with the metallic material for the manufacture of rude implements of various kinds, mainly serrated knives, but no traveler had hitherto succeeded in finding the locality of their occurrence, and only conjecturally, or as vaguely related by the Eskimos, was it assumed that the masses belonged to the immediate region of Cape York. Mr. Peary has now definitely located the spot, which is some twenty-five miles northeast of Cape York. Here, at an elevation of one hundred and thirteen feet above sea-level, and four hundred and fifty yards from the shore-line, lies the famous iron-stone, with a circumference of eleven feet, a maximum length of four feet and three inches, and a maximum width of three feet and three inches. The highest part of the stone above ground is fifteen inches, and the average thickness is perhaps one or one and a half feet. Mr. Peary estimates the weight at probably not less than five thousand five hundred lbs., and it may be double that. No analysis has as yet been made of the rock-mass, but seemingly it is of a constitution analogous to the well-known Ovifak irons, whether meteoric or telluric.

THE OPEN COURT.

Comments on Articles in Previous Numbers of the Review.

WHAT ELECTRICITY IS.—A brief review of the articles in the January number that refer to the original article under the above title in the October number,—by its author, F. Jarvis Patten.

Of the first article on the subject by Mrs. Moore, the writer can have but little to say, because he is forced to state that he cannot understand many of its terms. Being nothing more than a student of pure science, he looks for simple facts and cannot yet grasp or conceive any connection between pure science and "revelation," as the polite author of this criticism evidently does.

The writer would have these remarks apply in a general way but not in a precise degree to the third article in the January number, that by Henry Clay. If we must look to the book of Genesis for help in getting at knowledge not known or used by man for a few thousand years after the book of Genesis was compiled, and which makes no mention whatever of the later discoveries—then the writer begs to be excused from attempting further definitions, much less from attemping serious criticism of the Holy Writ and its meaning, of which he seriously professes no knowledge. The second article, that by Mr. Reed, seems to be written in a more serious vein. It is, at least, understandable by the author of the original article, and calls attention to some points that would appear to upset the original writer's definition as given. Upon close reflection, however, it would seem different. He says, "There is nothing new in the original author's definition." The author did not assert that there was anything new in it, or that anything particularly new as a discovery was intended. Nothing further, in fact, was attempted than to give for the layman or the scientific student a plain and understandable definition, or answer to the oft repeated question, "What is electricity?" and so far the writer has seen no good evidence that this was not accomplished. The incidents cited by Mr. Reed where the definition fails are in error, and the author feels certain that a little study will show them such; but space is too limited to take them up and analyze each in turn. Of course we may look at any form of energy as a condition of strain in the hypothetical ether, but this would hardly make electricity matter, because nobody says that the ether is matter, or has even a proven existence, but the same objections apply to any definition that we can give to any form of energy, and it would seem that we only invite confusion by resort to terms that few, if any, can understand.

EDITOR NEW SCIENCE REVIEW.—The interesting article by Mr. Morris in the January number, on the "Railroad in Asia," suggests to me in its reference to China, the thought that few who have not lived in that country understand, or at least appreciate, the influence of a class known as the "literati," exerted in opposition to all efforts by foreigners to introduce Western improvements.

My experience in the country dates at a period just before the attempts to introduce the first railroad, and my observation was chiefly confined to one of the smaller ports on the southern part of the coast line, but I think they would closely resemble those of residents in all other parts of the country.

The formidability of the influence of this so-called literary class was largely due to its subtle and irresponsible character. The vacillating conduct of the officials in diplomatic intercourse showed evidence of its effect on the one hand, and on the other the fiendish acts of violence committed by the lower orders were directly traceable to it.

Chinese customs and traditions, together with the weakness and chaotic state of the "central government," were unquestionable barriers to progressive enlightenment, but these could have been removed without serious difficulty, but for the baneful influence of the "literati."

The commercial class was truly progressive, and there was something to admire in their industry and adaptability. It is customary to dignify Chinese backwardness with the term "conservatism," whereas it is due rather to the implacable hatred of foreigners by the "literati."

Mr. Morris's reference to the present war suggests the only, or, at least, the most efficacious remedy. It will be remembered that the American Commodore entered Japan by first making a breach in the wall with his shot. That is the way I would overcome Chinese "exclusiveness." C. B. W.

SAN ANTONIO, TEXAS.

EDITOR NEW SCIENCE REVIEW.—* * * I am very enthusiastic about Mr. Jordan's system of mental training; so also are all the friends to whom I have shown the article. In fact, it appears to me that the great truisms about the mind therein made known must be appreciated by every one who reads it. Of course, having only read an outline, I necessarily know but a little about the system, but in the light of the truths apparent to me in this article, I am confident that a better understanding of the system would establish as a firm conviction my present opinion that Mr. Jordan is a benefactor of the race.

I have always believed that a better condition, mentally and morally, was possible, and it gives me pleasure to know a man whom I consider advances a system of mental culture, which not only makes this possible but inevitable, inevitable because these

ideas of mental training must, sooner or later, like all great truths that are advanced, become universally recognized and adopted. Hoping to be able soon to read further articles on this educational reformation, I am,

Very truly yours,

R. J. B.

ST. PAUL, MINNESOTA.

* * * I must confess that "Mental Training: A Remedy for Education," by William George Jordan, is a remarkable revelation, and clearly indicates how much energy is wasted in the old-fashioned method of education, and how poor the results. * * * T. M. Q.

Jordan's antidote to education, "Mental Training by Analysis, Law and Analogy," is a peach. Edgar W. Nye (Bill Nye).

BALTIMORE, Md.

EDITOR NEW SCIENTIFIC REVIEW. *Dear Sir*:—Maj-Gen. Drayton's article on examinations is irritatingly unsatisfying and incomplete. Examinations to-day are weak and inadequate, not only in themselves but because they are the product of a wrong basis of educating, as was so ably shown in an earlier number of the REVIEW. They must be treated as a symptom but not as a disease. Improving them will do little lasting good; the correcting must go further back and strike at the errors of the system itself. These annual or semi-annual inventories, stock-taking, do not attempt to determine the amount of growth from the months of study, but merely to see what percentage of the mental food has evaporated. True examinations must consider the facts as of slight importance if the mind has grown strong, quick and active by feeding on those facts, and to really recognize this in practice would require not only better examinations but new methods of teaching. EDUCATION.

"A Remarkable Book and its Teachings," By Prof. Lascelles-Scott, in No. 2, is one of the best written articles, and is certainly the most interesting of all. It reviews in a vigorous and conspicuously lucid manner Mrs. Moore's book, "Keely and his Discoveries," and it should be read by every scientist and layman who takes an interest in such questions. No such comprehensive and impartial exposition of the American inventor's claims has yet appeared. A. A. T.

A prominent English scientist writes of the January number, "Each article is suggestive. I believe it will have a largely increased sale in England. It seems quite clear of the dogmatic 'follow my leader' style, now so commonly adopted by English editors. Many great minds are rebelling against the popery of scientific authorities and are thinking for themselves."

To Oliver J. Lodge, Professor of Physics in the Liverpool University, we are indebted for the following pertinent remarks

on the "Mission of Science." The business of a scientific man is the pursuit of natural knowledge, and the imparting of such portion of it as has by long trial now become recognized and orthodox—*i. e.*, such portion as people are willing to receive. For I need hardly remark that at one time the science of nature or "physics" itself was very far from being orthodox, and that in past days promulgators of new truths had to pass not through the fire of a little friendly badinage and ridicule, but through fire of a much fiercer and more searching character; unless, indeed, they recanted their "errors." Instruction in orthodox branches of science is now permitted to youth; an unorthodox department of knowledge may have to wait many years before instruction in it can be willingly received even by adult and experienced minds. Let it wait! The instinct of an investigator and teacher is to set forth as best he may such natural truth as he is able to perceive—such truth as the interworking of his era and his opportunities have revealed to him—and there he must leave it. For its reception by the human race he is not responsible. When the time is ripe it will be both known and understood; till the time is ripe it had better, perhaps, not be known.

The universe is not so simple a matter as men in this century have been apt to think, and complete familiarity with the methods of commerce and of contemporary politics may be insufficient to solve it. All we ask for on the part of our contemporaries is an attitude of mind willing to give to new truth a chance of life. If it be of God they cannot, indeed, ultimately overthrow it; but they may by determined blindness seriously delay its coming, and entirely prevent its reception in their own age.

REVIEWS.

THE SOURCE AND MODE OF SOLAR ENERGY THROUGHOUT THE UNIVERSE, BY I. W. HEYSINGER, M.A., M.D. (J. B. Lippincott Co., Philadelphia.)

The work here named is one that apparently has a double mission to perform, that of giving an exposition, in popular language, of astronomy as at present understood, and that of stating and seeking to demonstrate the author's special hypothesis of the cause of solar light and heat. The latter purpose might, perhaps, have been as well performed in a work of much less extent, since much is stated that has no immediate bearing upon the hypothesis; while, on the other hand, the former purpose is only partly completed. Yet those who may take no interest in the author's hypothetical views will find themselves well repaid for reading this book by the rich store of astronomical information which it contains, and the easy and comprehensible language in which this is expressed.

As regards the hypothesis which is the *raison d' être* of the book's existence, it must be acknowledged that it is one of much interest in itself, and is very thoroughly worked out, while, if accepted as presented, it would save the universe from the fate that is predicted for it,—that of dying out like a fire destitute of fuel,—since according to the views here advanced an unending supply of fuel, or its equivalent, exists. Yet, despite this desirable end, and the simple method by which it is to be produced, the hypothesis does not appeal to us as a quite satisfactory solution of the difficulty, since it is based on conditions which are not known to exist, and on spheral relations which, if they exist, must themselves bring the present state of the universe to an end.

The hypothesis, simply stated, is the following: The sun and its planets are related to each other as great electrical machines, the sun the negative pole, the planets the positive poles of the celestial battery, while the (possible) matter of space serves as an intermedium of high conducting powers. This conduction is principally accomplished by aqueous vapor, which is claimed to be an universal constituent of spatial matter. The result is similar to that which we perceive in minor galvanic batteries, the giving off of free hydrogen at the negative pole, of free oxygen at the positive pole, and the eventual conversion of the electrical force into heat. It is well known that free hydrogen exists in abundance in the solar atmosphere, while there is no indication of free oxygen. The opposite condition exists upon the earth, whose atmosphere contains free oxygen, but no free hydrogen. The aqueous vapor of our atmosphere, and the water of the earth are, according to the author, due to the inflow of the

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aqueous vapor of space. The final result of the process is that the electrical current, on reaching the free hydrogen of the solar atmosphere, meets with resistance, and is converted into heat, by which the hydrogen is raised to a state of incandescence, and the solar heat and light produced. If it be asked, What is the necessarily continuous source of this electric current? the author's reply is that it is due to the friction of the terrestrial atmosphere with the matter of space; the earth, in its rapid axial revolution, and its still more rapid movement through space, acting as a great electrical machine, and developing currents of electricity of an exceedingly high potential.

This hypothesis is worked out by the author with great elaboration and much skill, and is shown to be in consonance with the phenomena of the aurora, magnetic storms, the repulsion of the tails of comets, and various other phenomena both of solar and of stellar space. Its weak point is that it begs the question in several particulars. While aqueous vapor *may* exist in stellar space, and in its rarified condition *may* freely conduct electricity, we have no actual evidence of its existence or of its conductive powers. Again, the incessant production of free oxygen in the earth's atmosphere should evidence itself in an increasing percentage of oxygen in the atmosphere. There is no evidence of such an increase. Finally, there is to be considered the friction between the earth and the assumed matter of space which the hypothesis requires. Such a friction must check both the diurnal and the annual revolution of the earth, and in time end the operation, by bringing all the planets into the sun. So far as evidence goes no such retardation exists. The author must prove its existence before he can hope to sustain his hypothesis.

TWENTY-FIVE YEARS OF SCIENTIFIC PROGRESS, AND OTHER ESSAYS, BY WILLIAM NORTH RICE, PH.D., LL.D. (Thomas Y. Crowell & Co., New York.)

The twenty-five years of scientific progress here alluded to are now thirty, since it is five years since Professor Rice delivered the essay now printed before the American Society of Naturalists. In that thirty years the progress of science seems, in many respects, marvelous, and though it doubtless looms up particularly from our nearness of view, yet the sum of advancement, as epitomized in this address, is certainly very considerable. This will be seen if we mention the most important of these steps of progress. First of all, the theory of evolution, born just before, has had nearly its whole progress, from general denial to general acceptance, within this period. To-day the scientist who is not an evolutionist is almost a *lusus naturæ*. Then the opposite state of things prevailed. During the period named the science of bacteriology has had its birth and growth, and the time-honored medical science of the past has been revolutionized by the germ theory of disease. There has been remarkable progress in our knowledge of the minute structure of plant and animal tissue, in our acquaintance with deep sea life, and in the details of zoölogical classification, in which the simplified systems of Cuvier and Agassiz have vanished

from sight, and a much greater diversity is shown to exist. As regards geology, the progress in filling the gaps in the animal series has been immense; birds have been shown to be near relatives of reptiles, the serial development of horse ancestry and of other animals has been discovered, and man himself has been traced back to an antiquity that no one previously dreamed of. The science of lithology, or petrography, has immensely added to our knowledge of rock structure; the theory of the winds has been born and developed; atmospheric gases have been reduced to the liquid and solid states; numerous organic substances have been produced chemically; photographic plates of extraordinary sensitiveness have been developed; the practical applications of electricity have been most remarkable; astronomical discoveries of the highest importance have been made; and, in short, a degree of progress achieved which it is doubtful if any previous period of the same length could equal.

In addition to this very interesting address, Professor Rice writes of "Evolution," "The Degree of Probability of Scientific Belief," and "Genesis and Geology," all in the same pleasant and attractive strain, the little work which he presents to the public being, in its concise statement of facts, a very full one.

LESSONS IN THE NEW GEOGRAPHY, BY SPENCER TROTTER, M. D. (D. C. Heath & Co., Boston.)

In this work Dr. Trotter, who is Professor of Biology in Swarthmore College, Penna., has taken a new departure, and produced a book for the use of scholar and teacher alike, which cannot fail to be of the utmost advantage. It is neither political geography nor physical geography, though some attention has been paid to the latter, but may perhaps be best designated as biological and commercial geography—or geography in its relations to man—and in this field the work is remarkably compact and full of useful information, occupying a place in the school-book domain which has hitherto been unfilled.

"The geography of our childhood," says the author, "is remembered by most of us for its dry-as-dust details and its interesting pictures," in which animals were jumbled together in a way in which they are never seen in real life, not even in menageries. "We learn, too, that the land was divided into continents, islands, peninsulas, seaports, capes, and so forth; that Canton was noted for tea and china, Yokohama for Japanese, Philadelphia for Independence Hall, Rome and Greece for antiquity, and Buenos Ayres for hides and tallow. But we never knew *why* they were noted for these things, or what part their geographical position played in their history and exports."

It is the *why* of things of this kind that Dr. Trotter undertakes to give, dealing with such subjects as Past and Present Aspects of the Earth; Climate; Plants and Animals which have Affected Man; Races of Men and their Geographical Distribution; Commerce and its Products, and various analogous subjects—all of these being considered in their geographical relations and their connection with the physical features and climatic

conditions of the earth. As a new departure the book seems to us a marked success, compact in treatment, diverse in subject, and logical in arrangement. It is a capital addition to the school-books now in use, and alike as an aid to teachers, a supplementary reading-book for scholars, and a text-book for advanced classes, it fills a vacant place and fills it well.

WHAT ORMOND THINKS, BY "ORMOND." (The Blakely Printing Co., Chicago.)

"Ormond" thinks that man is a dual being, material and spiritual, and that when the material returns to the state of unorganized matter the spiritual will continue to exist as organized spirit. There is nothing particularly new in this. Great numbers to-day think, and in past times have thought, the same thing. And as regards demonstration of the statement, it must be said that this work leaves it precisely where it found it, as something insusceptible of scientific evidence. "If any reader," the author says, "is unfortunately so constituted mentally that they must have proof for everything they believe, it would be well for them to study all metaphysical subjects until they find it easy to believe without proof, save their own powers of reasoning." The logic of this sentence is about as obscure as its grammar. The author has set out to demonstrate a position, and ends by telling his readers that those who are not ready to believe without proof need mental overhauling. Perhaps so, but as it stands Ormond acknowledges a failure in his argument which renders the book itself the reverse of a necessity.

THE SUPREMACY OF THE SPIRITUAL, BY EDWARD RANDALL KNOWLES, LL.D. (Arena Publishing Co., Boston.)

As the preceding work asserted that man is dual in constitution, the present one asserts that he is single, and that this singleness is a spiritual, not a material, one. He goes further, and propounds the hypothesis that the "ether" of space is the spiritual substratum from which all seemingly material things arise. "This single universal medium," he says, "is not only omnipresent, but immaterial, and hence not of the material existence and its conditions and laws, but spiritual." "And right here," he continues, "we recall the fact that already many scientific men have supposed the so-called 'ether' to be homogeneous with the immaterial, simple substance, the soul."

It is no difficult matter to *suppose*. The difficulty always is to *prove*. The suppositions of these scientific men—who, by the way, are not on record—are of no more value than any unscientific suppositions, and do not yield us a speck of evidence that the ether is immaterial, or spiritual. It is only through its material operations that we know of the existence of the ether at all, and unless matter itself is immaterial ether certainly is not. As for the author's arguments, they take very much the shape of assertions.

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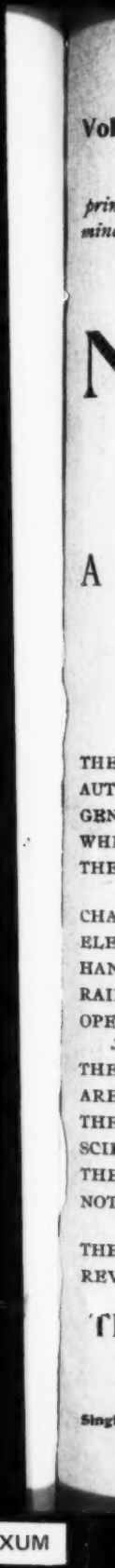

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"All that has been predicted of atoms, their attractions and repulsions according to the primary laws of their being, only becomes intelligible when we assume the presence of mind."—SIR J. F. W. HERSCHEL.

THE NEW SCIENCE REVIEW

A Miscellany of Modern Thought and Discovery.

Conducted by J. M. STODDART.

APRIL, 1895.

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REVIEWS.

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THE REVIEW OF REVIEWS

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During the many succeeding years of its success under the direction of Warlomont, the Annales attained to a still greater influence. In all its fifty-seven years of existence Annales d'Oculistique has maintained its position as a leader in ophthalmological thought and as a most complete record of the grand progress of the science.

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Of those who have served upon its staff as regular collaborators, it is sufficient to recall from the long list of distinguished names those of Sir James Bowman, Ed. Jaeger, Sichel, Giraud-Teulon, Lawrence, Mackenzie, Crittchet, and Desmarres; while such illustrious teachers as Von Graefe, Donders, and scores of others who have lent the greatest impulse to the progress of ophthalmology, have employed its pages to record their studies and their experiences.

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It has long been the wish of the directors to make the journal in every respect an international medium of communication between all who are interested in the study of its branch of science.

With the January number the member of the staff who has for the past four years acted as the American collaborator assumes the direction of an edition to be published in English.

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In future issues original communications from American and English writers will constitute a much more prominent feature in the pages of the journal than they have in the past.

The aim of the directors, on both sides of the Atlantic, will be not only to maintain the distinguished place which the journal has always occupied in ophthalmological literature, but to advance its usefulness with the progress of the science.

The journal will be, as it has always been, free from personal bias, serving only the cause of scientific truth.

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Paul Janet, in writing of the origin of the philosophy of Comte, said, of the different and contrary conceptions found in various so-called systems, that they arise, he thinks, from the fact that no true system of philosophy has yet been propounded, and that only when a "véritable système" has had birth will all these diversities and contradictions disappear from the teachings of the schools.

However willing thoughtful men and women may be to admit that science has done a great work in cleaning away "the kitchen middens of superstition," they see that "her methods are at fault and that the results are disappointing failures." Edward Carpenter, in a criticism on modern science, says: "Science has failed because she has attempted to carry out the investigations of nature from the intellectual side alone, neglecting the other constituents necessarily involved; she has failed because she has attempted an impossible task, for the discovery of a permanently valid and purely intellectual representation of the universe is simply impossible, and it must be confessed that science now finds herself, in almost every direction, in utterly hopeless quandaries. The views of science are like the views of a mountain; each is only possible as long as you limit yourself to a certain standpoint; move your position and the view is changed, and just where she is most ignorant she is most definite and dogmatic."

If, as Carpenter asserts, science has landed herself in pure absurdities in every direction, while the unknown thing remains unknown, the independent existence around the corner still escapes us, the time has come in which it may be well to look into a philosophy that for the first time gives us a system which teaches "a vast organization, absolutely perfect and intimately knit, from its center to its utmost circumference, existing embryonic in every individual man, animal, plant, or other organism, the object of all life, experience, suffering and toil—the ground of all sensation, and the hidden, yet proper, theme of all thought and study."

This is the philosophy which Keely's system discloses, as made known in Mrs. Bloomfield Moore's book, "Keely and His Discoveries." It is asserted that Mr. Keely has demonstrated his ability to "hook on his machinery to the machinery of nature," drawing therefrom a harmless propelling and controlling power, which, it is claimed by him, is the force that controls the universe, and the only one safe and suitable for navigating the highways of the air.

The book is dedicated to Professor James Dewar, M.A., LL.D., F.R.S., M.R.I., "in admiration of his distinguished services for science and in grateful acknowledgment of his prolonged and steadfast interest in Keely's work of evolution."

In the words of the Rev. John Andrew, who has written the preface, "the aim of his volume is to show the course of events in relation to Keely's researches, and to open the mystery of how it came about that he should have been so much misunderstood and hindered," as he has been, as well as to bespeak for him the sympathy and patience which he needs, and will continue to need, until his system is completed to that degree of perfection which will enable him to patent his air-ship. Another step taken toward that conquering of the material world which must precede the advent of the reign of the spirit, Renan asserts in his "Avenir de la Science."

After Mrs. Bloomfield Moore's book was completed and in print, she received from Mr. Grant Allen the following prefatory note, intended for its pages, and which cannot fail to create an interest in the publication:

"In this volume Mrs. Bloomfield Moore endeavors to give some account of the physical philosophy of Mr. Keely, who claims to be the discoverer of an unknown energy. There can be no doubt at all that Mrs. Moore is thoroughly competent for the task she has set herself, for no other person has been so intimately associated with Mr. Keely's work during the last ten years, and no other has followed it throughout with such disinterested and single-hearted enthusiasm. It is impossible not to sympathize with so rare a determination to assist struggling genius. In Mrs. Moore's opinion, Keely has made great discoveries, and she has generously devoted no little time and trouble to aid the inventor in gaining public recognition. Now, I am a heretic in physics myself, though my heresies are not the same as Mr. Keely's, and, therefore, I am interested in the general principle that all heresies should meet, at least, with a fair and open trial at the bar of scientific opinion. That fair and open trial is now demanded for the views promulgated in the present volume. All its author asks is an impartial judgment, and Mrs. Moore is herself so conspicuously honest and candid that she deserves no less at the hands of specialist critics.

"The work, as I regard it, is rather concerned with Mr. Keely's theories, and with Mr. Keely's philosophy, than with his actual performance. Now, what the world most wants is rather proof positive and material of the existence and reality of the unknown power. As soon as it can be made to 'do work' (if I may borrow the very unsatisfactory phrase of the modern physicist), practical men, I take it, will be only too glad to employ the latest known form of energy. It appears, however, that grave difficulties are supposed by many to stand in the way of the practical utilization of the alleged motor. Till those difficulties have been overcome it is but natural that an incredulous world should stand by and suspend its judgment, if, indeed, it does not refuse to so much as suspend it. But Mr. Keely is fortunate in having found a supporter whose faith rises to the full height of so painful a situation. If success should ever crown his life-long efforts, it will be largely to Mrs. Moore's unfaltering encouragement for the last ten years that the world will owe its new motor.

"With regard to the theoretical part of the present work—and it is mainly theoretical—I should be inclined to say that a great many of the principles for which Mrs. Moore contends have now been reckoned among the probabilities, or even the certainties, of science. Such are the principles of the unity and uniformity of energy, the reductibility of all energies to a single ultimate kind, and the underlying antagonism between forces and energies. But others, more novel, are couched in a new terminology of Mr. Keely's invention, and are difficult for the physicist to correlate with the ordinary principles known to science. To say this is not, of course, equivalent to condemning them, for every new science has had to begin by inventing its own terminology, and electricity, in particular, passed at first through a stage of very curious nomenclature, proved by later research to be in large part erroneous. But the language in which Mr. Keely clothes his ideas is so peculiar to himself that it cannot readily be followed by physical investigators. Much of it, I must confess, conveys little meaning to me. Nevertheless, I have honestly done my best to grapple with the reasoning involved, and I shall watch henceforth, with the greatest interest, the final developments of Mr. Keely's mechanism.

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(See next page)

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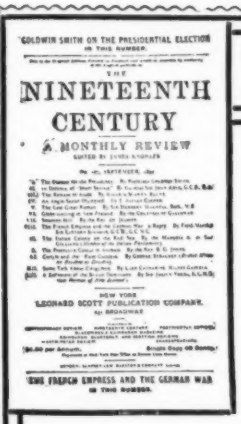
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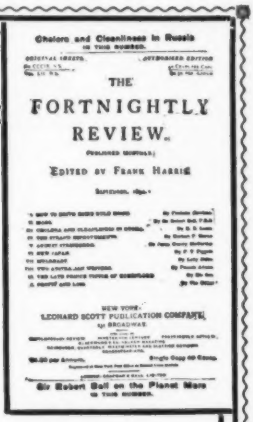
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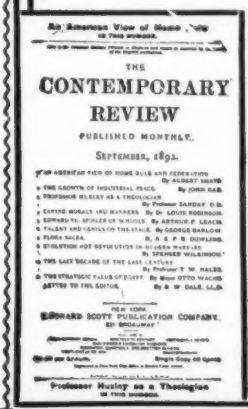
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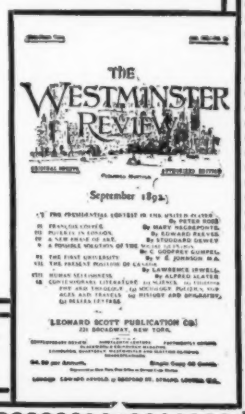
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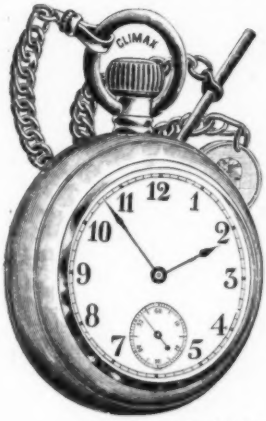

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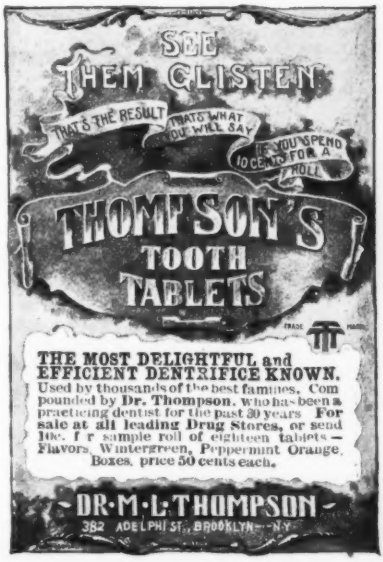
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It is hoped that the department called the "Open Court" may assist the approximation to this ideal. While fairly full in this number, it is not all that it might be. Again the request is made for criticisms, as direct and fearless as possible, of all articles now or heretofore published. Such criticism is the best means to enable the managers to learn the wishes and the wants of their readers.

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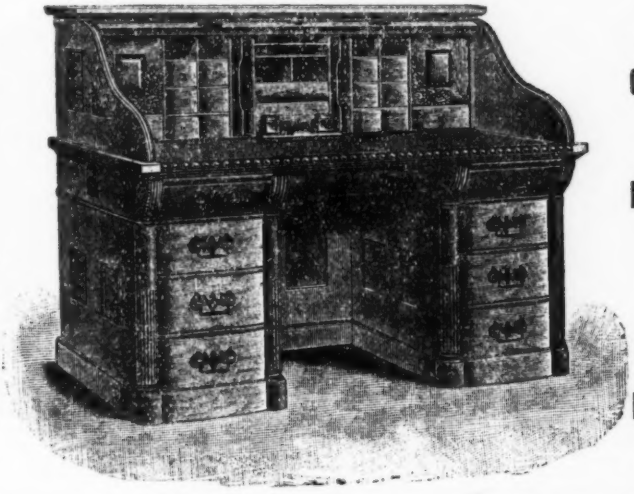

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